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[ILLUSTRATED]

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Henderson's Grip System for Electric Railways.

In all of the earlier electric railroads the general idea was to use the rails as the conductors for the current, and while theoretically it is the best and cheapest way, yet in practice it was found to have so many disadvantages as almost to be useless, for the following reasons: First, difficulty of good insulation; second, good, cheap contact at the butts; third, poor contact from the surface of the rails, on account of mud, sand, rain or other cause; fourth, danger to animals, as well as the continuous action of the road by coming in contact with, or accidentally or maliciously, some conductor getting across the track; fifth, the great drawback, that no matter how powerful the motor, or the current used, the tractive force was limited to the weight of the motor car, so much so, that a steam motor with its boiler, water, fuel and extra machinery, can, by its extra weight, exert a far greater tractive force in going up a railroad grade, to say nothing of the very heavy grades on street railroads in some cities, that are at present only overcome by the aid of the cable system.

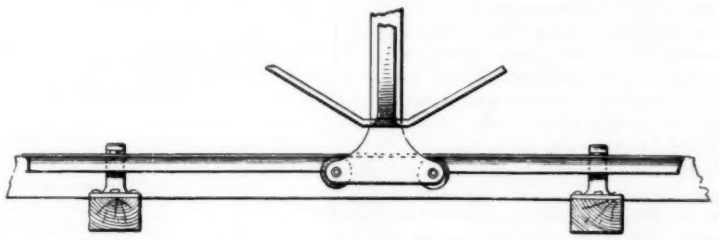
Of course there are many ways of overcoming it both as regards steam and electric motors, by the aid of cog pinions and racks, magnets, etc , etc., but nothing practical, especially for use in cities; and of course, any attempt to carry extra weight to overcome a grade, would only be a very large extra expenditure of power on a level, and an element of danger when descending a grade. The Henderson Grip System for Electric Roads, not only does away with all these drawbacks, but possesses advantages of its own.

The cable road, for instance, runs only in one direction, and at a uniform rate of speed. If it overruns at a switch it has to be pushed back by manual labor. To stop instantly, in case of danger, two operations are necessary, one to disconnect the grip, the other to apply the brakes. In going around a sharp curve, extra machinery and appliances have to be used, as the strain of miles of wire rope with its load would break and destroy any grip between the rope and the rollers that are necessary to take it around the curve.

Again, the life of a steel cable is a very uncertain affair, liable to have its life very much shortened by careless gripping, besides being quite an undertaking to replace, to say nothing of the whole road being at a standstill (or the expense of a horse reserve), while it is being replaced. Then again there is the amount of friction with its consequent necessary lubrication, at all of its sheaves, carriers and rollers, all along the line, with its required attendance, to say nothing of its nuisance to adjacent householders by its constant rumbling day and night, and lastly, the great drawback of requiring all of its power and machinery at one place, irrespective as to whether it is the cheapest place to locate or not on the whole line.

Again, on a suburban road, with its turnouts and single track, a cable road would be very expensive.

As to other electric roads, it (the Henderson system) is better than the overhead cable with jockey car connection, as it is not only underground and out of the way, but is impossible to increase the traction by an overhead cable. The same applies to all of the others whether taking the current off from the rails direct, or an independent one for that purpose, as they all more or less interfere with the street-way of a city, and don't give traction.



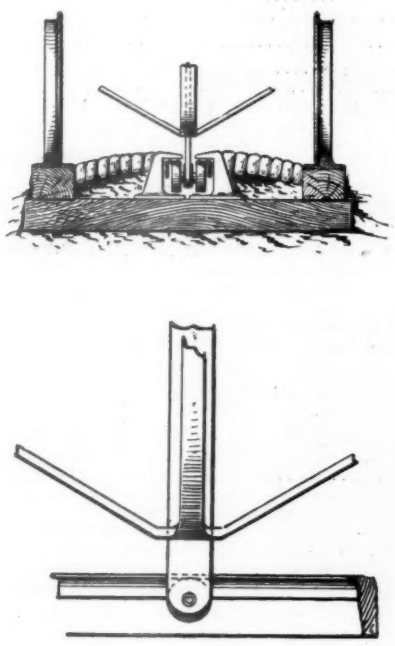


Fig. 1

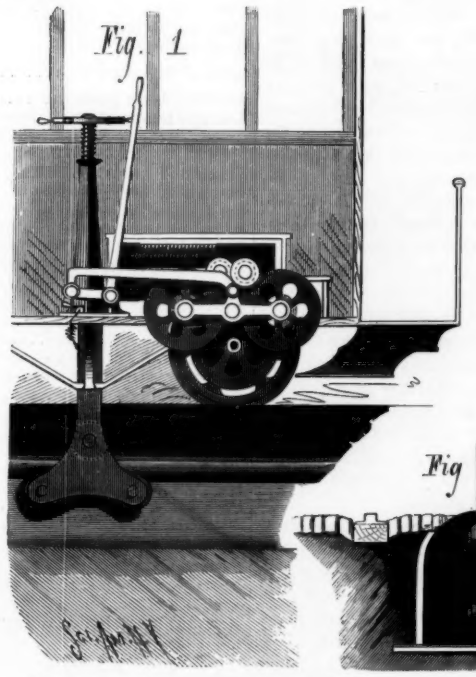


Fig 2

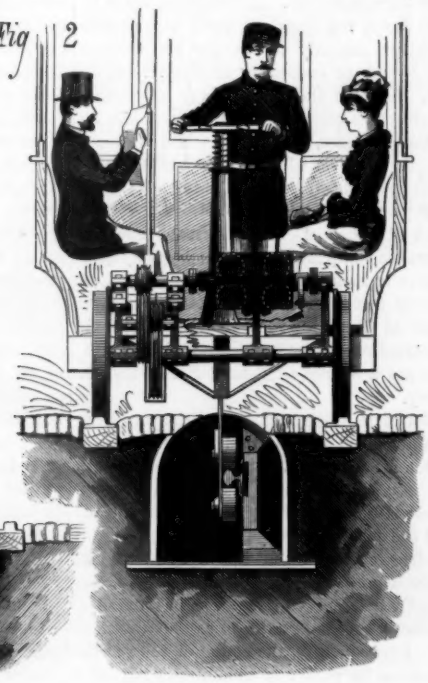
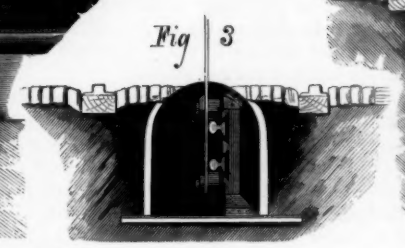


Fig 3



HENDERSON'S GRIP SYSTEM FOR ELECTRIC RAILWAYS.

In the Henderson system, in case of danger, one movement would throw the whole tractive force in the other direction instantly, with its full tractive power that at the time was being used, irrespective of the weight of the motor car. Again, as a brake, it is very efficient, as it acts on all the wheels at once.

The car can, of course, be reversed, and run back, when over-running a switch; or, in case of a large conflagration in a city, by simply introducing two or three cross-overs in the length of a line, the road can be kept in operation.

The conduit can be constructed of iron, concrete, or timber, according to the locality; and having no movable steel cable running through it, the other space could be rented out for the locating of electric light and other wires. Of course, street lamps, as well as the car lamps, could be lighted from the conductors; and in any locality where surplus power is procurable at a cheap rate, it can be turned into the main conductors, and used in localities where it is neither allowable nor procurable. Finally, it can be built and operated for less money than a cable road, and a cable road can be very easily changed into an electric grip road, having the conduit already in, and power ready to drive the dynamos instead of drums. As to its use on elevated roads, it is hardly worth while taking up the subject, as it has been gone over and over again by all advocates of electrical railroads; but with this grip system above the ties to overcome any grade, and draw its full quota of cars and load, it would greatly reduce the weight carried, with its consequent wear and tear, to say nothing of the absence of gas and cinders for the benefit of the public and the saving of one man on each motor for the benefit of the company.

The description of the Henderson system will be clearly understood by the accompanying diagrams. A fixed bar or bars, according to requirements, are supported in a conduit under the level of the track in the same manner as in the cable system, insulated by chairs or shoes at the supports. The grip taking hold by rollers under the bar and up through the bottom of the motor car, so that by screwing down on the grip bar you give all the tractive power requisite on the wheels of the motor-car, the grip at the same time conveying, in insulated recesses, the current up to the motor, and back from, and to the bars, as the case may be or the locality require; for, in some instance it may be advantageous to use only one bar, getting the return through both rails and the iron conduit.

In the working model its practicability is very evident, and proves conclusively that if electric railroads are to be used in our streets it is the most feasible plan.

Sir Henry Bessemer now holds 114 patents on his many inventions. It is said that his steel process patent brought him $600,000 a year for twenty-one years.

The Chambers Lightning-Rod.

By E. W. Claypole.

In the second part of the third volume of the proceedings of the Davenport Academy, is a short paper by W. H. Pratt, entitled "The Chambers Rod and the Phœnix Mill Fire." In that paper it seems to me that Prof. Pratt has satisfactorily proved that the fire in the mill was caused by lightning. The fact that the mill was clean, and had not been running for some weeks, is sufficient to meet the allegation that the fire may have been caused by spontaneous combustion, aided by explosive dust. It might have been added, that there was no explosion. Moreover, one man bore distinct testimony to having *seen* the lightning strike the mill.

The mill, it appears, was fitted with the "Chambers" rod, the peculiarity of which is that it has no ground connection, and professes to dissipate the electric charge without conveying it to the earth. Much discussion has been aroused in regard to the protective power of this mode of constructing and setting up lightning-rods. Experience, which should be the final court of appeal, is not, in this case, so conclusive as it might be. Lightning rods of all kinds are so carelessly put up, and, what is more, so carelessly kept up, that accidents from lightning are not infrequent even to "protected" buildings. That well-made and well-kept lightning-rods are, however, not only efficacious, but thoroughly effective, in preventing damage, is proved by the fact that no loss has been sustained by the British Navy from this cause since the adoption of Sir W. Snow Harris's lightning conductors. It should be borne in mind that a rod does not avert the electric discharge, but only the danger and damage that would be caused by an electric explosion. Ships of the British Navy are probably struck as often now as formerly, but no explosion ensues, and no mischief is done. Yet, in spite of all the "protection" afforded by lightning-rods in this country, in some parts of which every house and barn is fitted with them, I cannot learn that the fire insurance companies make much or any diminution in their rates of premium on buildings so fitted. These remarks apply to all kinds of lightning-rods. Whatever their construction, unless well made and well kept, they are a source of danger rather than of safety.

But there is an element of danger in the Chambers rod, arising from the principle on which it is constructed, that does not exist in the case of the usual "earth-fast" rods. These latter act on the principle that the air and the earth are always in opposite states of electric tension. Our knowledge does not allow us to say if this is absolutely and necessarily true, but experience shows that it is perfectly safe in practice to assume that it is so. Consequently, the action of the rod depends on its power of communicating by a continuous and infusible conductor between the one and the other, by which means the electric tension is equalized, either by a slow and silent discharge, as commonly occurs, or by a sudden and sharp flash.

The Chambers rod, on the other hand, is constructed on the principle that different masses of air are also in different conditions of electric tension, and that these different masses of air are very near each other. The first of these two principles is true beyond question. This is proved by the constant passage of sparks or flashes of lightning between cloud and cloud, or, more accurately speaking, between one body of air and another, without "striking" the earth at all. Probably this is by far the commonest mode of restoring the disturbed equilibrium. Not one flash, apparently, among hundreds that occur, strikes the earth, or anything upon it. Were it otherwise, so many storms could not happen without any mischievous consequences. Comparatively seldom do we hear that anything or anybody has been struck by one of the hundreds of electric flashes occurring during every summer. They discharge themselves in the air. An overcharged mass relieves itself by "flashing" into one with less tension at no great distance. So far, the principles on which the Chambers rod is constructed are well founded.

But the second principle is open to grave suspicion, and this suspicion, to say the least, is a serious objection to the general adoption of this system of "protection." In assuming that these masses of air of unequal electric tension are in close proximity, the advocates of this system claim more than can be granted. Without raising any question of the meaning of the word "proximity," it is evident that it must mean "striking distance." Now, that two masses of air of unequal tension are usually within striking distance is amply proved by the fact above mentioned – that almost all the electric discharges occur between cloud and cloud. But that this is not always true is proved with equal certainty by the other fact that sometimes the discharge takes place between the cloud and the earth. Against the former we need no protection, because discharges between masses of air of unequal tension are harmless to the earth and things on it. It is the latter kind of discharge solely against which lightning-rods are intended to afford protection. The assumption that a mass of air overcharged is always near enough to one that is undercharged to flash into it being baseless, renders any mode of protection founded upon it to a great extent untrustworthy. I say to a great extent, because a mass of overcharged air, though naturally out of reach of a mass of undercharged air, may be brought within reach of the same by artificial means—and this is what is attempted by the Chambers lightning-rod. A cloud or over-excited mass of air at one place may be out of striking distance of a mass of under-excited air, but if a long copper rod be laid from one to the other, or from near the one to near the other, the spark may pass. Consequently, if a large or long building be fitted with the Chambers rod, with no earth connection, it is more than probable that some of the most distant points will be beyond the influence of a thunder-cloud that is able to discharge into a nearer one, and may, consequently, take the charge and pass it off into the less electrically intense air that overhangs them. In this way, a building so protected may be struck and not injured. It is, however, obvious that this protective power must rapidly diminish with the size, and especially with the length, of the structure; and when this is reduced to small dimensions, it is more than possible that all the points are within striking distance of the same cloud. Consequently, there is, then, no discharge, and the danger to the building is vastly increased by the presence of the rod.

Now, the Phœnix Mill was a structure of this kind. It measured only fifty by thirty feet, and all its points were probably within the influence of the mass of excited air from which the flash proceeded. Not having any path provided for its escape, it took the conductor and then the building in its passage to the earth. It is needless to add that on this view, an ordinary conductor, with good earth-plate, would have efficiently protected the building.

It may be replied that the conductor was insulated from the roof, but the reply would be futile. It matters little or nothing whether this conductor, or any other, be insulated or not. A flash that can leap from the cloud to the rod can certainly leap from the rod to the roof.

The necessary inferences from the views above put forward are :

1. That the Chambers rod possesses no virtue which ordinary rods do not possess, except a slightly lower cost.

2. That the Chambers rod can, and doubtless does, in many cases, protect buildings when they are extensive and the points at considerable distances from each other.

3. That the Chambers rod loses its virtue when applied to small buildings.

4. That the Chambers rod has least protective power when the danger is greatest—that is when the mass of charged air is very large.

5. That while these objections diminish the protective power of the Chambers rod, a rod with good earth connection of sufficient size, and in perfect order, with a sufficient number of points, affords protection, if not absolute, yet so nearly absolute that the danger from lightning to a building thus protected is infinitesimally small.

Boiler Tests.

The following tests were made at the station of the Edison Electric Illuminating Company, of Brockton, Mass., to determine the difference in economy between Babcock & Wilcox sectional boilers, burning bituminous coal, and a steel tubular boiler, with the Jarvis patent furnace and Sheffield grate, set to burn a mixture of anthracite screenings and bituminous coal, both boilers using natural draft.

Water, coal, refuse, etc., were carefully weighed on scales, and the tests were made as nearly comparative as it was possible to make them, the only material difference being that more of the incandescent lamps were in use during the test of the Babcock & Wilcox boilers than were in use during the test of the tubular, owing to a theatre being lighted. The water, after having been weighed, was fed to the boilers, in each case, by a Deane steam pump, through a National feed-water heater.

The Babcock & Wilcox boilers comprised two, of nominal rating, 75 horse-power each; the steel tubular was of dimensions, 6′ diameter, 16′ long, containing 140 tubes 3′ diameter, 15′ long, boiler rating nominally 1250 horse-power.

Tests were conducted by Mr. C. A. Hammond, of the Jarvis Engineering Company, assisted by Mr. E. H. Dewson, Jr., of the Massachusetts Institute of Technology. All observations, weights, etc., were also taken by a representative of the Edison Company.

REPORT OF TESTS.	Steel Tubular Boiler and Jarvis Furnace.	Babcock & Wilcox Boilers.
Date of tests	Dec. 3.	Dec. 5.
Duration of tests	16 h. 7 m.	16 h 5 m.
Grate surface..... sq. ft	36	42
Kind of fuel used	1 part Soft Coal, 3 parts Screenings.	Clear Soft Coal.
Average steam pressure..... lbs.	85.16	87.22
Average temperature of feed water..... °F.	209.16	208.38
Pounds of fuel consumed { 200 lbs. wood figured } Screenings..lbs.	2250	
Pounds of fuel consumed { equal 100 lbs soft coal } Soft coal....lbs	850	3800
Pounds of ashes and refuse	400	285
Pounds of combustible	2700	3515
Per cent. of ashes and refuse	12.9	7.5
Pounds water evaporated under actual conditions	32458	37004
Equivalent evaporation from and at 212°	33724	38521
Pounds water evaporated per pound of coal under actual conditions	10.47	9.74
" " " coal from and at 212°	10.88	10.01
" " " combustible, actual conditions	12.02	10.53
" " " combustible from and at 212°	12.49	10.96
*Cost of fuel consumed	$5.85	$8.56
Pounds water evaporated at 212° for $1 worth of fuel	5765	4500
Economy shown by use of tubular boiler, Jarvis furnace and screening mixture	22%	
Horse-power developed by indication of Armington & Sims' engines at comparative times. 5 o'clock P.M.	96 H. P.	94 H. P.
6 "	96 "	105 "
7 "	92 "	92 "
(From 9 P.M. until 7 A.M. the power varied, being at times as low as 10 H. P. 8 "	104 "	112 "
9 "	104 "	128 "
Factor of evaporation	1.039	1.041

*Cost of Coal—Soft Coal, $5.05 per 2240 lbs.; Screenings, $3.50 per 2000 lbs.

Screenings in quantity can be laid down in Brockton at $3 per ton, in which case economy shown would have been 30 per cent. instead of 22 per cent.

Breaking a Copper Pool.

THE PLANS OF THE COMPANIES TO MAINTAIN PRICES DISARRANGED.

The *Times* says for years the Lake Superior copper mining companies have joined in agreements to regulate prices and prevent unprofitable competition. One, pooling the production of the following companies and running to January 1, 1885, was executed February 14th last—Calumet and Hecla, Quincy, Atlantic, Central, Allonez, Franklin, Pewabic, Huron, Conglomerate, and Copper Falls. August 20th last a new contract was executed, to run from January 1st next to March 31, 1886. Under the contracts the Calumet and Hecla was to market the entire production of the Lake Superior region and divide the amount received according to the quantity of copper produced by each company. Channing Clapp, of Boston, the Vice-President of the Calumet and Hecla, says, in an affidavit, that his company made contracts for many thousand tons of copper in Europe. No more was to be sold in Europe than the amount covered by the contract, and the parties receiving it were to import none of it back into the United States. Despite the agreement, the Quincy arranged to deliver copper in Europe. When the agreement was made the companies were mining more copper than there was a market for. To have entered into general competition would have brought the price of copper down below the cost of production. In the Supreme Court Chambers, a motion to continue an injunction pending the trial of a suit is to be heard by Judge Lawrence to-day. Daniel Seymour, of Miller, Peckham & Dixon, the attorneys for the Calumet and Hecla, which sues in the name of itself and the other companies, said the Quincy Company had, contrary to the terms of the agreement, sold copper itself, and thereby practically broken the market to the injury of the other companies. The agreement was in writing, and was a binding contract. W. P. Todd, the Treasurer of the Quincy, said his company sold because it could obtain a better price than the Calumet and Hecla. The Quincy did not care for the continuance of the contract, and the suit begun by the other companies would decide its validity.

In the metal trade, the breaking of the contract was not looked upon as a matter of great importance, except to the companies themselves. Since the development of the mines in Montana and Arizona, it was said, the supply had been far in excess of the demand, and the agreement of the Lake Superior companies was solely to preserve their local interests, as it could no longer rule the market price. John F. Heyne, of J. W. Heyne & Brother, said that now 130,000,000 pounds were produced in this country a year, or about twice as much as was required for home needs. About 70,000,000 pounds a year were produced in the lake mines, and the Calumet and Hecla mined something like two-thirds of this. The lake copper, except in the case of the Calumet and Hecla, was much more expensive to produce than the western copper on account of the rock excavations. The breaking of the agreement would not affect the market because it was over-supplied. The effect would be on the Lake Superior companies alone. Since the development of the Western mines prices had gone down. Two years ago copper was 18 cents against 12 asked and 11⅞ bid yesterday. The market was very much depressed.

—— The light of an electric lamp travels at the rate of 187,200 miles a second; that of the sun, 186,500; and that of a petroleum lamp, 186,700.

The Harrington Rotary Engine.

A new rotary engine involving principles heretofore unemployed and said to be capable of very high speed under economical circumstances is represented in perspective and in sectional detail in the cuts published herewith. As will be seen, it is compact in form, occupying but little floor space. It may be made of any size, double or single, and is intended for general use. For electric lighting and other purposes requiring high speed and freedom from oscillation, it is said to be peculiarly adapted. The several parts are simple, and are so made as to possess great strength and capacity to resist wear. Care has been taken to provide complete lubrication and to avoid friction. The chief characteristic or principle of this engine is the maintenance of an accurate steam and mechanical balance and the avoidance of cross pressure. The power is applied directly to the work, the only friction being that of the steel shaft in phosphor-bronze bearings. Referring to the cuts, Fig. 1 shows the engine and an electric dynamo on the same shaft, all connecting mechanism being done away with and pounding obviated. There are but two parts to the engine (two dics which supply the place of all the ordinary mechanism) both of which are large, solid and durable. These discs have a bearing surface of several inches on each other preventing the passage of steam between them—a feature peculiar to this engine. Figure 2 represents an end elevation partly in section, showing the piston *A* and the abutment disc *B*, in the position assumed in the instant of taking steam through a port from the valve-chamber *E*. Fig. 3 is a vertical section through the center of Fig. 2, showing the relations of the discs *C*, and the abutment discs *B* and gear. The piston discs and gear are attached to the driving shaft *H*, and the abutment discs and gear are attached to the shaft *K*. These shafts, *H* and *K*, as above stated, run in taper phosphor-bronze bearings, which are adjustable for wear or other causes by the screw-caps *O*. The whole mechanism is kept rigidly in place by the flanged hub *r* bolted securely to the cylinder head *F*. These flanged heads project through the cylinder head, touching the piston disc, and thereby prevent any end motion of the shaft *H* or its attachments. The abutment discs and shaft are furnished with similar inwardly projecting flanged hubs, which are provided with a recess *I*, Fig. 2, on their periphery, located radially between the shaft *K* and the clearance space *J*. Into this recess steam is admitted—through an inlet in the cylinder head not shown in the cuts. By this means the shaft *K* is relieved of all side pressure. The exhaust-port, which is very large and relieves all back pressure, is shown at *D*. The pistons and discs are made to balance at the speed at which the engine is intended to run. The steam-valve, for which a patent is pending, is new in principle. It has a uniform rotating motion, and, like the engine, is steam and mechanically balanced. The governor is located in the fly-wheel, and actuates the automatic cut-off, with which it is directly connected, without the intervention of an eccentric, in such a way as to vary the cut-off without changing the point of admission. By this means is secured uniformity of motion under variable loads with variable boiler pressure. It also secures the advantage resulting from high initial and low terminal pressure with small clearances and absence of compression, giving a large proportionate power and smooth action.

Expansion has been excellently provided for, the steam passing entirely around before entering the cylinder. These engines are mounted on a bed-plate which may be set on any floor without especial preparation therefor. The parts are all made interchangeable. A permanent indicator is provided which shows the exact point of cut-off. The steam-port is exceptionally large, being one-fourth or the piston area. Reciprocating motion is entirely done away with. The steam is worked at the greatest leverage of the crank through the entire stroke. Among the other chief advantages claimed for this engine are direct connection to machinery without belts, etc., impossibility of getting out of line, uniform crank leverage, capacity for working equally well, slow or fast, etc. It has but one valve, which is operated by gear from the shaft, as shown, traveling at one-half the velocity of the piston.

With this engine, a speed of nearly 5,000 revolutions per minute is attainable. An engine of this class was run at the Illinois Inter-State Exposition at Chicago for six weeks at a uniform speed of 1,050 revolutions per minute, furnishing the power for twenty-three electric arc lights, with a steam pressure not exceeding fifty-five pounds per square inch, and cutting off at from one-tenth to one-sixth of the stroke. It was taking steam from a large main-pipe, so there was no opportunity for an exact test of the amount of fuel used, but from a careful mathematical calculation it must have been developing nearly one horse power from three pounds of coal.

The inventor claims that, as his engine works the steam expansively, even better results would have been obtained had the engine been furnished steam at 100 pounds per square inch.

That this is a departure from the ordinary types of rotary engines that have been built, tested and rejected, is proven by the fact that all of the seventeen claims made were allowed practically without amendment by the Patent Office at Washington. Patents have also been applied for in all foreign countries.

The motion under all circumstances being continuous, the shock of incessantly starting and stopping the masses of metal making up the engine is avoided, and the expenditure of power therein saved.

The Harrington Rotary Engine Company, Chicago, Ill., are the owners and manufacturers.

Fig. 3.

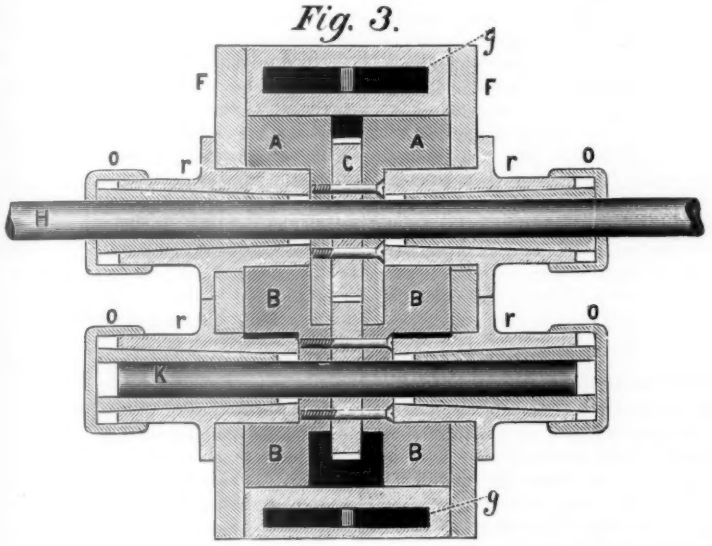
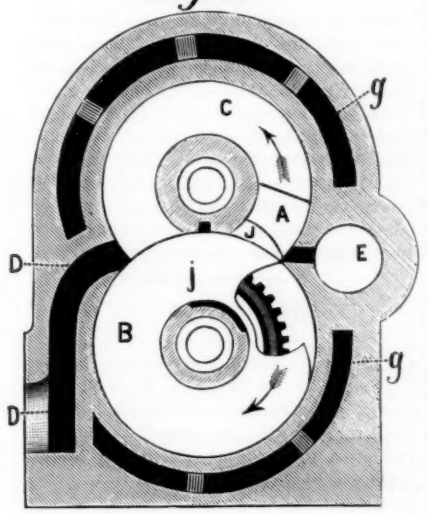


Fig. 2.



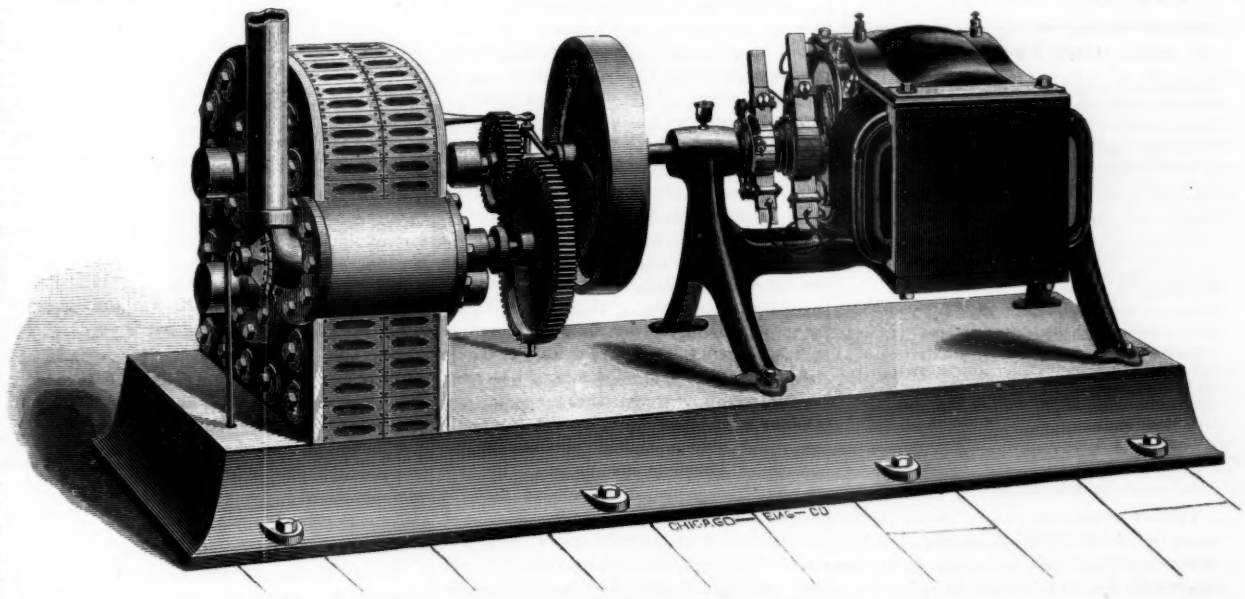


FIG. 1.—THE HARRINGTON ROTARY ENGINE COUPLED TO DYNAMOS.

Legal Ohm Standards.

M. I. René Benoit, who was commissioned by the Minister of Posts and Telegraphs, France, to construct several mercury standard ohms, has now completed the work, which was carried out at the Bureau International des Poids et Messures, Paris. The tubes employed are of the thickness of ordinary thermometer tubes and 1.20 meter long. The bore is one square millimeter in sectional area, and as regular as could be obtained. A scale in millimeter divisions was engraved on the tube over a length of 1.05 meter. The tubes were carefully calibrated and inserted in reservoirs of mercury. Being long and somewhat unmanageable, M. Benoit has constructed copies in tubes which curve several times on themselves. These standards have been constructed with such care that the average error in their resistance is exceedingly small. M. Benoit in fact considers that their mean error is about $\frac{1}{100000}$ of the ohm.

The *Times* says: The rate of 40 cents a word announced by the Commercial Cable Company as its regular tariff for transmitting transatlantic messages has already had its effect on the older lines. It will doubtless have a greater effect upon the business of ocean telegraphy. From "$100 for 20 words," which was the rate of 1866, to the present price is a great stride, but there is no reason to believe that we have as yet reached a bottom price. The idea of making money by doing a large business at a small profit has taken possession of every department of trade in which the demand is not fixed and limited. The business of telegraphy is eminently one in which the demand will increase as the price is lowered. It takes about three weeks, on an average, to get an answer by mail from London, and the question whether a very large proportion of the commercial and even personal correspondence between New York and London shall be done by mail or telegraph is simply a question of the cost of telegraphy. The enormous extension of postal correspondence caused by reductions in the rate of postage shows what may be expected from like reductions in cable rates.

The rapid strides now being made in electrical science and the practical application of electricity to the various needs of every day life, are most forcibly brought to the minds of visitors to the establishment of Mr. Chas. L. Bly, No. 37 Pearl St., Boston. Mr. Bly who was for several years with the well known firm of Stearns & George, succeeded to their business about two years ago, and by close observation of the requirements of the community in his particular line, has been able to keep in advance of the rapidly increasing number of electrical experts. He has been fortunate in retaining the services of several of the most experienced workmen in the city, his factory being under the supervision of Mr. Harrison Whittemore who is well and favorably known to the electrical public. The products of Mr. Bly's workshops are of a varied character, embracing nearly every electrical invention brought to public notice, and many others of which the community is yet to be informed. Notably among the many mechanisms turned out by this establishment are the electric match-clock, gas gauge, water-register, hotel annunciator, gas lighting apparatus, burglar alarms, fire indicators, etc. One of the latest productions being an electric arc lamp of peculiar construction, pronounced by experts to be a decided improvement upon those now in use, and believed by Mr. Bly and his friends to be of great commercial value. Visitors to this establishment are sure of a cordial welcome, whether purchasers or otherwise, and are invariably the recipients of such gentlemanly treatment that they are sure to call again and bring their friends.

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We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

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NEW YORK, JANUARY 3, 1885.

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Further argument will be heard by the court in the case of the American Bell Telephone Company's application for injunction against the Baxter Overland Telephone Co., at Philadelphia, on the 8th inst.

Is 1885 to be an eventful year in matters electrical? Are any of the long-promised practical results of experimenting in all sorts of directions likely to be attained? Are we to have any radical improvements in batteries, primary or secondary? Are we to see any simplification and consequent cost reduction in dynamos? Is electricity to come into use this year as a source of power beyond the fragmentary and uncommercial way in which it is now employed? These are the questions that electrical persons are asking to-day. The answers, which cannot be known for a twelve-month, will depend more on electrical people than on anybody else. If they take a practical view in handling their inventions and discoveries, practical results will be attained. If they get up into the clouds and fondly imagine that they have dropped on something that has "millions in it," and hold out for the millions, the result, practical and financial, will have a good deal of very thin moonshine in it. No charge for the advice, brethren. Take it with our New Year compliments.

POOLING THEIR PATENTS.

It is a wise move on the part of the various companies, and individuals holding patents which concern the use of the electric current as a means of propelling railway trains, to seek to come together on some common ground, and unite their rights under one joint ownership, to the end that the introduction of electro-motors for moving trains may be no longer delayed. The delay which has occurred, and at which many have wondered, has grown out of the fact that no one dared to make a move, fearing litigation. Common sense and mutual concessions ought to enable the different parties to get at an equitable base in a reasonably short time, and this is certainly better than reaching the same conclusion at the end of a long and costly law suit. Just as the differences which existed between the Western Union Telegraph Company, representing Mr. Edison, and others, and the American Bell Telephone Company, representing Professor Bell, and others, were healed by consolidation, in which still others joined, avoiding litigation which would have been practically endless, and opening the field for the immediate introduction of the telephone into general use, so we believe that an equitable basis of agreement can be reached by those having an interest in electric railway patents, which will secure to every one his rights and open the way for the very general use of electricity as a motive power on railroads, especially in cities.

UNDERGROUND TELEGRAPH WIRES.

The report which Sir William Thomson has submitted to Mr. J. W. Mackay, as the result of his experiments in telegraphing over underground wires, is a very important contribution to the subject, especially in that part which refers to the speed of transmission attained. So far as the *possibility* of telegraphing over a buried conductor is concerned, it has not, we believe, ever been questioned by any one whose opinion was of the least weight. In the matter of speed, however, others whose experience in underground telegraphy has been larger than Sir William's, and whose opinion is certainly entitled to high consideration, differ from him very materially on the question of attainable speed. It was Mr. Preece, if we mistake not, who said that not more than one-fourth the service could, *in practice*, be got out of a buried conductor as out of one suspended overhead. His opinion is, therefore, distinctly at variance with that of Sir Wm. Thomson; but, in justice to Mr. Preece, it should be stated that the opinion quoted was given by him over a year ago; that the opportunities for experiment have, no doubt, greatly improved in the meantime; and that it was on cables placed at Sir William's disposal, through the courtesy of Mr. Preece, that the former's recent tests were made. The cable recommended is a costly one, copper wire separately insulated with gutta-percha, and this heavily armored with iron wire, the whole protected with a hemp covering. As will be seen, the production of such a cable—which is, to all intents and purposes, a submarine cable, and has—what is unnecessary in underground work—a breaking strain of four and one-half tons. It certainly would seem as though telegraph companies, before ordering cable of this expensive sort in large quantities, might profitably consider the expediency of testing long lengths of cable of much cheaper construction.

One reason why the telegraph is so universally used in America is the fact that telegraph offices are to be found on every hand. No such frequency is to be expected when all telegraph lines go underground. It is a small matter to run a wire to a new hotel, set up an office, put in an operator, and find out whether it will pay. If it does not, the whole work can be undone at small cost, and one "strike" will more than compensate for half a dozen mistakes. But when it comes to running a cable, the whole thing assumes a different aspect. It simply will not be done. Should all the telegraph wires in New York go underground, it is safe to say that three out of every four branch offices now open will be closed, and that no new ones, except on the direct line which the trunk cables follow, need be looked for. Thus, while the introduction of cables will add materially to the necessary outlay for plant, they will tend to decrease the amount of business, especially as the same law which puts all telegraph wires below the surface will wipe "call boxes" out of existence.

That we are progressing towards the time when a very great proportion of the wires now overhead will be represented by conductors in underground cables or conduits of some sort, we both hope and believe. That we are going to do away with overhead wires entirely, we do not expect. That the time has come for some systematic method of stringing such wires as are to remain overhead, there can be no question, for herein lies the key to the solution of one great difficulty and cause of complaint. So long as different companies are permitted to string their wires according to their own sweet will, regardless of anybody's rights, an outcry against *all* overhead wires is not unnatural. A system, to which all should be held amenable, would do away with half the complaints.

We venture the assertion, by way of prophecy, that in ten years from to-day—say, in January, 1895—New York will have more miles of wire underground than she has overhead to-day, and that every foot of buried wire will have its counterpart overhead, but arranged in such a way as to cause neither danger nor reasonable complaint. And may we all be there to see!

A CURIOSITY OF LITERATURE.

Even in the dull routine of business correspondence a curiosity of literature comes to the surface now and then. We were this week shown a letter which fills this bill completely, and, as a sample of "monumental cheek" it certainly deserves to be framed and preserved. In the left hand upper corner appears this card "Barton H. Jenks, Mechanical Engineer, 319 Willings Alley, Room 6," and the date is Philadelphia, Dec. 20th, 1884. Here follows the text of the letter:

Electric Development Co.
197 Congress St., BOSTON. MASS

GENT.—I have been called upon by an established company in electrics, who for certain purposes, desire a *patent* for a dynamo machine—their desire is *only* to own such a *patent*—If the dynamo is *impracticable* by reason of too much cost in obtaining an electric current, or otherwise, it will more completely suit the requirements, as they will pay but a small sum, or small amount of their stock, for such a "Machine Patent." Can you accommodate my parties, and at what cost, or can you refer me to some one, having an impracticable dynamo with whom I can correspond? Your favors will be appreciated and reciprocated by

Yours Respectfully.
[Signed.] "BARTON H. JENKS."

The reply which Mr. Barton H. Jenks received to this communication must have surprised not only him but his client of the "established company," if he deemed it prudent to show it to them. It was as follows:

BOSTON, Dec. 22d, 1884.
Barton H. Jenks Esq., M. E.
319 Willings Alley, Room 6, Philadelphia.

SIR.—Your favor of the 20th inst. saying that you had a party who wanted to buy a patent for dynamo machine, and that it was immaterial whether it was good for anything or not—simply wanted to own a patent on which stock could be issued, is just received and contents noted. Permit me to say that the kind of business which you speak of is one which is not at all familiar to this company, and if you want to buy a "Snide" machine or patent the market is full of them, and it is unneccessary that you should come to Boston to find such as will suit your purposes.

Respectfully
[Signed.] EDWARD H. GOFF, *Pres.*

It would be interesting to know just what "established company" it is that is so anxious to secure the patents upon an "impracticable" dynamo, and for what purposes they desire it.

A DISTURBING RUMOR.

The rumor current early in the week that the new cable company was to "pool issues" with the older ones, and thus keep up rates, has caused a good deal of talk in the daily papers, and not a little lamentation. Whether this rumor is founded on fact we do not, at this writing, positively know, but it is very certain that the question at issue is not one of sentiment, but of money, and whatever will put most money into the pockets of the parties in interest will certainly be done. The following, from the financial column of the Boston *Transcript*, reviews the past history of "public-spirited rivals" in an interesting way:

"Now the American and English nations are to be stirred up by the rival cable companies, each having for its aim no other intent than private gain, and it will be the old, old story in the end, illustrating Mr. Fink's maxim, that where union is possible, competition is impossible. How long shall a suffering public continue to have its sympathies aroused in favor of a young and presumably weak, yet public-spirited rival to the older telegraph concerns? It ought to make every American business man blush to think how, in the days of the American Union he fought for Jay Gould, and went two blocks down street just to give his business to the new concern, thus helping Mr. Gould and his friends to find some basis for securing three dollars of capital for one dollar of investment in American Union, sweat Vanderbilt and the public out of Western Union, and then made another $15,000,000 in a 40-per-cent. dividend stock just as a sweetener to the consolidation, while the public is taxed with round rates, a most inefficient service, and employees being ground down to the lowest possible living. Who pays, and pays dearly, for the opposition cable and telegraph schemes? The public and the telegraph operators. It is the same in railroading, as the people of New York State will learn when Vanderbilt has swallowed his West Shore blackmailer, and the people of the Mohawk Valley have to pay the expenses and interest charges of two roads instead of one. The American Union Telegraph Company never earned its expenses—some well-informed people say it did not half earn them. The mutual Union came nearer, and might have earned its expenses in a single month but for its legal expenses. The Rapid Telegraph Company ran $119,200 behind the last year before it was merged into the Bankers & Merchants', and the Bankers & Merchants' can't now show any net earnings."

Underground Telegraph Wires.

REPORT OF SIR WILLIAM THOMSON UPON THE RESULTS OF RECENT EXPERIMENTS.

The results of Sir William Thomson's recent experiments on the employment of underground wires for telegraph lines are given in the following report to Mr. Mackay, and are interesting because he proves conclusively that all the overhead wires, which are now in the city a source of so much disfigurement and danger, could be placed underground without impeding telegraphic traffic:

No. 18 Fitzroy Street, London, W.
J. W. MACKAY, ESQ.,

DEAR SIR,—In the report which we now have the honor to submit on the employment of underground wires for telegraphic communication, we have made no attempt to treat the subject exhaustively. We believe that your object was to obtain our opinion on two broad questions—whether a telegraphic system could be worked rapidly and efficiently through underground lines, and whether these lines would be durable. Messrs. Siemens recommend an underground cable similar to that which is used by the German Government.

This cable contains seven copper strands, each weighing 90 pounds per mile, and

insulated with gutta-percha weighing 76 pounds per mile. The seven insulated wires are contained in a sheath of 24 galvanized iron wires, each 0.102 inch diameter. The weight of the iron is about 4,080 pounds per mile. These iron wires are further protected by jute and compound. The weight of the whole cable is about 6,100 pounds per mile. Its breaking strength is four and a-half tons. This type of cable is well suited for the purpose to which it is applied.

Experience has shown shat cables of this description buried in the ground without further protection are extremely durable, and are exposed to very few accidental injuries. We are unable to fix a term to the life of these cables, because up to the present time no similar cable has, we believe, required renewal or shown any sign of serious injury. These remarks apply both to the iron sheathing and the gutta-percha core. No insects have, as far as we know, attacked the gutta-percha in these or similar cables, either in this country or in any other. The experience in temperate climates has been large, and some very considerable lengths have been employed by the German Government to form a network of lines for military purposes. In hot countries some experience has been derived from short lengths of cable used in trenches on land to connect submarine lines with land stations. In some cases extreme heat has injured these short connecting lines, but we believe that this has occurred only where proper trenches could not be dug for their protection. We are, therefore, of opinion that, as regards durability and freedom from accidental interruption, underground cables would give very satisfactory results.

The transmission of messages through underground wires is subject to two actions which tend to limit the number of signals which can pass from station to station in a given time. The name induction is commonly applied to both these actions, which may be distinguished one from the other, as static induction between the copper conductors and the earth, and magnetic induction between adjacent insulated wires. We believe that in all cases likely to arise in practice magnetic induction may be neglected, and, moreover, its effects can in some degree be neutralized by judicious arrangements. The effects of static induction cannot be eliminated by any known contrivance. The well known limitation of speed through submarine cables is due to static induction, and a similar action takes place in all underground wires. Formulae derived from submarine lines enable us to calculate with considerable accuracy what traffic can be passed through long underground lines of a given type when these are worked with the same expensive instruments as are employed for submarine lines. Thus, with the type of cable described above, we reckon that by using the siphon recorder or mirror instruments, a good clerk would work at his full speed, sending from 20 to 30 words per minute through any length not exceeding 1,000 miles. A high class of clerk would, however, require to be employed, and it is possible that magnetic induction from wire to wire would, in these great lengths, be inconvenient. We do not believe that transmission by underground lines in this manner would be likely to compete on favorable terms with transmission by overhead wires. It has, therefore, been our duty to satisfy ourselves as to the traffic which could be carried on by ordinary apparatus through the underground lines. The officials of the English Post Office informed us that they were without any knowledge on the subject, but Mr. Preece, the engineer in chief, was, however, so obliging as to offer us for experiment the use of some new underground wires now being laid near London, and we made a series of experiments, with the following results, using a good Morse recorder and a Wheatstone automatic sender:

Length of Line. Miles.	Words per Minute.
27	more than 220
88	130
116	100
181	35

On the length of 181 miles a similar experiment was tried with hand sending and a Morse sounder, as the receiving instrument worked by a relay; 30 words per minute were sent, and probably the full speed of 35 words could have been reached by a good clerk. The general conclusion is that for short lengths, such as 30 miles, extremely rapid sending by automatic instruments might be employed, and duplexing, or even quadruplexing might be employed. On lines of 100 miles automatic instruments could still be employed with advantage, but the effects of static induction would be quite sensible, and would render any speed greater than 130 words per minute difficult of attainment. The ordinary hand signaling was to be practised with no sensible impediment on all lines under 200 miles in length, and at this distance relays could be worked, retransmitting the messages automatically, so as to connect places distant from each other by at least 500 miles. There is no doubt whatever that any amount of traffic could be worked through a system of underground wires at the usual rates of hand sending.

The expense of establishing underground cables must always be greatly in excess of the cost of aerial lines capable of transmitting the same amount of traffic. But in cost of maintenance, we believe that an underground system would compare very favorably with aerial lines. Underground wires will also be almost wholly free from interruptions due to storms or to extremes of heat and cold, whereas aerial lines, however well constructed must always be subject to injury from wind, snow and extreme cold.

We have heard it suggested that lines composed partly of underground wires and partly of suspended wires would be more difficult to work than lines constructed wholly on the one or the other system. This is an error. It is, however, perfectly in accordance with the theory that the addition of any considerable length of aerial wire to a long underground circuit will materially reduce the speed of working. The reduction in the speed will, however, be less than if the length of line added were also composed of underground wires. Thus, in the experiments already spoken of, an addition of 50 miles of aerial line to the 181 miles of underground line reduced the speed from 35 to 28 words per minute. But if an additional length of 50 miles of underground wire had been added, the speed would have fallen to 15 words.

Very sincerely yours,

THOMSON AND JENKIN.

A pretty, as well as novel, Christmas tree was shown to a few friends by Mr. E. H. Johnson, president of the Edison Company for Electric Lighting, in his residence, No. 139 East Thirty-sixth Street this city last week. The tree was lighted by electricity, and children never beheld a brighter tree or one more highly colored than the children of Mr. Johnson when the current was turned and the tree began to revolve. Mr. Johnson has been experimenting with house lighting by electricity for some time past, and he determined that his children should have a novel Christmas tree. It stood about six feet high, in an upper room, and dazzled persons entering the room. There were 120 lights on the tree, with globes of different colors, while the light tinsel work and usual adornment of Christmas trees appeared to their best advantage in illuminating the tree. Mr. Johnson had placed a little Edison dynamo at the foot of the tree, which, by passing a current through from the large dynamo in the cellar of the house, converted it into a motor. By means of this motor the tree was made to revolve with a steady, regular motion. The lights were divided into six sets, one set of which was lighted at a time in front as the tree went round. By a simple device of breaking and making connection through copper bands around the tree, with corresponding buttons, the sets of lights were turned out and on at regular intervals as the tree turned around. The first combination was of pure white light, then, as the revolving tree severed the connection of the current that supplied it and made connection with a second set, red and white lights appeared. Then came yellow and white and other colors. Even combinations of the colors were made. By dividing the current from the large dynamo, Mr. Johnson could stop the motion of the tree without putting out the lights The mechanism by which the shifting of the lights is made has been patented by Mr. Johnson, who believes that its use will be invaluable in scenic effects. The changes can be made with clockwork regularity, while the field for combinations and effect is almost unlimited. There is no house in the city in which electrical lighting is put to more novel uses than in Mr. Johnson's. As one enters the parlor a bright grate fire attracts the attention. On examination the discovery is made that it is of colored paper, which is never consumed, but under which electric lights are hidden. The brilliancy of effect of the painting on a porcelain urn surprises the visitor. Inside the jar is an electric light. The brightness of the chandeliers and brackets is emphasized by means of the electric lights. The house is the first in the city in which electric lights were supplied from a current generated in an isolated plant. The dynamo is in the cellar, and makes so little noise that it cannot be heard on the floor above. A small engine supplies the dynamo, and the steam, after running the dynamo, is using in heating the house. Mr. Johnson's experiments have proved most satisfactory in almost every respect, and he has promised to make a connection with one or two of his neighbors' houses, that they may also be lighted with electricity.

Editors Electrical Review:

GENTLEMEN,—Your editorial remarks in your last issue touching a convention of managers is timely. I would be glad of such an occasion to exchange, through such a channel, Southern experience in the lighting business with that of managers of other sections. There are many vital questions that can be legislated on—the pole system, right of way through towns and cities, the best manner of fulfilling contracts for public lighting, the best and safest manner of insulation in all of its branches, and, as you say, "cheapen, simplify and make more popular." Men of experience (though small) now confidently feel that the arc light has come to stay; furthermore, the masses of the taxpayers of all towns and cities are convinced that it is the light for street illumination. If electrical apparatus and all supplies could be cheapened, and the managers of local companies throughout the country could procure as large a number of public lights as they have private ones, the business would prove more satisfactory. Can we not convene somewhere for the good of the business? I would suggest, not the time, but the place, New Orleans—the Exposition Building. This would offer an opportunity for the friends from the snowy West and those from the icy North to visit the world's show, to see the golden fruit and white rose in mid-winter, and see something of the South and her progress. A convention would, no doubt, bring about wholesome changes for the good of electrical manufacturers and their representatives, the local companies. As you say, the business is new. I for one desire to learn. The business needs more students than it does of some of the self-important, self-regulating dynamo experts that roam the country.

Respectfully, etc.,

R. P. WEBB.

N. B.—The city law-makers have just passed a resolution requiring the Cumberland Telephone Company here to place their wires in cables on poles eighty feet high—(dangerous, if not impossible). They have now a splendid system of poles fifty-five feet high. We shall see what we shall see.

Memphis, Tenn., Dec. 22, 1884.

Editors Electrical Review:

DEAR SIRS,—An editorial note in your paper of December 13th says "that in most cities—Boston being one of them—the electric lights used for lighting the streets are placed higher in the air than need be. The thing to be done is to light the streets—*the ground*, not the *air*," etc.

Even if the principal object were to light the pavement, that we might watch our footing, I think the angle of reflection would be so much better with the light placed high than low that we should be gainers. But I think your statement is wrong—the principal objects of the lighting being to enable wayfarers to easily distinguish other moving object, and this cannot be done with a glare of light on nearly the same level with the eye, causing shadows to cross the range of vision, and making it almost impossible to see anything between one's self and the next lamp.

To be satisfactory, the lights should be placed high enough to keep the shadows down, so that a passing hack, for instance, need not darken the ground for a distance of more than a few rods.

In this city the electric lamps are usually placed about twenty feet above the ground. Bromfield Street (something over 500 feet long) is lighted by a single lamp, placed midway in its length. Devonshire Street is lighted by lamps placed more than 400 feet apart. So it appears that each lamp is expected to illuminate for a distance of more than 200 feet in each direction.

The accompanying diagram shows that a point on the pavement 200 feet from the foot of the lamp-post would be 201 feet from the light if it were placed at a height of 20 feet, and only 8 feet further, or 209 feet from the light, if placed at a height of 60 feet; and in the latter case the angle at which the light reaches the eye is much less trying to the nerves, and the interference of shadows is much reduced.

A point on the pavement 100 feet from the base of the post would be 102 feet from the light if placed at a height of 20 feet, and 117 feet from the light if it were raised 60 feet from the ground. This difference is not great when we consider that the business of the lamp is to light a space of 200 feet around.

Nearer than 100 feet the light is sufficient for all the ordinary purposes of street illumination, and is just as good if the lamp were raised 60 or 100 feet as at 20 feet.

I should favor, then, the raising of the lights in our streets to a height of about 60 feet, or nearly on a level with the eave cornices of the buildings; and it is only by some such change that we can avoid the fearful glare on the eyes.

Yours very truly,

JAMES P. TOLMAN.

Boston, Mass., Dec. 27, 1884.

Mr. E. F. Phillips of the American Electrical Works, Providence, R. I., has just issued a calendar for 1885, which is one of the finest specimens of the kind published this season, as his many friends in the electrical field have all had occassion to bear witness to.

At the electrical exhibition now open in Boston, the Security Electric Signal Company of New York, exhibits a signal box for hotels which, by moving a crank, sets call bells in every room ringing simultaneously, and continuously, in case of fire. If we mistake not, the Western Electric Company of Boston and New York have patented an invention of this kind which covers more ground than this, as it answers the purpose of room and office call, fire alarm, annunciator, etc.

It was illustrated in the REVIEW of September 27th, 1884.

The fire alarm system in Boston during the past few weeks has been extended and improved, so that now there are 365 fire-alarm boxes and about 300 miles of wire. The number of circuits has also been increased from twenty-one to thirty-six. The superintendent has also established in various department houses a number of batteries, by which, in case of the destruction of the fire-alarm office, a complete fire alarm system can be put in operation throughout the city in a very short time.

Telephonic News

*** Telephonic conversation has recently been successfully carried on between St. Petersburg and Boulogne, a distance of 2,465 miles.

*** There is a perplexing confusion in the reckoning of time at Pittsburgh, Pa. Of seventeen railroads centering there, six use eastern standard time, nine central standard time and two local time. This necessitates the use of clocks with two dials, on which railroad and local time are marked.

*** The annual report of the Chamber of Commerce of New York, shows the value of the merchandise imported into the United States for the fiscal year ending June last, was $705,123,000, of which there passed through New York $486,355,000. The exports from the United States were valued at $775,190,000, of which $363,055,000 were shipped from New York.

*** With regard to this system of simultaneous telegraphy and telephony, the *Bulletin* of the Societe Belge d'Electriciens remarks that it does not depend on the use of special microphones or telephones, as in the early experiments. Nor is it any longer necessary to amplify the telephonic voice so as to overcome the noises due to telegraph induction; on the contrary, this induction is annihilated by the graduation of the telegraph currents.

*** The Tropical-American Telephone Company has sold its Barbadoes exchange and business to the Barbadoes Telephone Company, Limited, an organization formed by local capitalists on the Island of Barbadoes, W. I.; and that company will continue the business under its own management.

The Tropical Company turned over to it 120 paying subscribers, and they expect to increase the list to 150 subscribers within a few months. The rate at Barbadoes is $5 per month, and "Bell" and "Blake" instruments are, of course, used.

The Tropical Company still owns and operates the exchange at Trinidad, where 140 paying subscribers are in telephonic connection.

*** The "New Telephone Company," of London, which has been formed for the purpose of working the telephone patents taken out by Professor Sylvanus Thompson and Mr. Philip Jolin, was registered on the 20th ult., with a capital of £120,000, in £5 shares. Among the subscribers are Mr. J. A. Sellon, of Messrs. Johnson, Matthey & Co.; Lord Thurlow, the chairman of the Anglo-American Brush Electric Light Company; Lord Sudeley, and Sir Daniel Cooper. The new company will have to face litigation with the United Telephone Company at the outset, and the statement that Sir Farrer Herschel, Sir Henry James, Mr. Horace Davey, Q. C., M. P., and Mr. Bousfield have been retained by it as counsel is significant.

*** The net output of telephones for the month ended Dec. 20 was 379, against a net loss of 335 the previous month and 419 for the same month last year. The net increase for 10 months of the fiscal year, compared with 1883 and 1882, is as follows.

	1882.	1883.	1884.
March	5,192	4,739	3,252
April	6,690	7,342	4,483
May	7,469	6,758	5,023
June	6,362	7,038	4,568
July	3,787	5,846	2,278
August	4,678	3,569	616
September	4,276	4,365	1,374
October	4,136	3,706	299
November	5,033	3,811	*335
December	4,532	4,191	370
Total increase	52,155	51,365	21,937

*Net loss.

Future of the Telephone.

A TALK WITH PROFESSOR BELL—ITS USE TO BE LIMITED ONLY BY THE CONTINENT—IMPROVEMENTS CONSTANTLY STUDIED.

Professor Alexander Graham Bell, the inventor of the telephone, spent several days in New York last week. On Saturday he talked freely to a reporter of the telephone and of its increasing usefulness, and of other inventions which are being developed.

"The time is not distant," said Professor Bell, "when all of the larger centers of population in this country will be connected by telephone wires and when they will be in easy and satisfactory telephonic communication. There will be a grand central office, probably in New York, and all of the other central offices in the country which it is desirable to reach will be connected with it. When this system of connecting central offices has been developed it will be as easy for a subscriber in New York to call up a friend in San Francisco and to engage him in conversation as it would be to call another subscriber to the telephone in the city of New York. All movements in telephone circles tend to this system of united central offices. I can see very plainly that it must become national in its scope. Many centers of population in the several States are connected by telephone wires. It requires no special gift of prophecy to see that all of these small systems of central offices can and will be blended and united into one vast, complete system, which shall be limited only by the boundaries of the country or the continent. New York and Boston are already connected by a telephone wire, or rather by two wires. The circuit is made complete by the use of a double copper wire. By means of the double wire all disturbing influences are diminished, and induction is reduced to a minimum. The telephone service between New York and Boston is very satisfactory, and there is no reason why the wires cannot be made to work over a much longer distance."

"Does the company expect to extend the wires and bring the great cities of the South and West into telephonic communication with the cities of the East?"

"Well," said the Professor, laughing merrily, "I do not know that I can answer that question for you with satisfactory precision. The fact is, I make it a point to know as little as possible about the business details of the company. I need all of my time for work in the laboratory and am really quite ignorant of the working plans of the company; but it is my impression that all of the great cities, and indeed all of the centers of population of any importance, will be placed in telephonic communication. Just how soon this end can be reached I am unable to say, but things seem to be working in that direction, and it will not be long before you can converse with your friends in the great cities of the West. After the wires have been extended to all of the great cities in the United States, the union of the central offices of which I have spoken will be speedily effected."

PLACING WIRES UNDERGROUND.

"Would not the telephone service be improved if the wires were all placed under ground?"

"It would be of vast benefit to the service. Every telephone wire ought to be buried. Every city ought to compel the telephone companies to lay their wires under ground. The corporations will never do it, I fear, until they are required by law to do so. It would be very expensive, but it ought by all means to be done. It would remove the wires from all the disturbing influences to which they are now subject when stretched on poles, and it would relieve the streets and buildings of the city from a steadily and rapidly multiplying network of wires, which sooner or later will become troublesome, if not dangerous. It would be a considerable and direct benefit to the public to have all telephone wires under the ground. Crossed and swaying wires would become an impossibility, and the service would be improved in a variety of ways. Burying the wires would probably not increase the cost of the telephone to subscribers, but it would increase its usefulness wonderfully. I have small doubts that public sentiment will recognize these facts before a great while, and that the telephone companies in the great cities, and elsewhere, too, I hope, will be required to bury their wires. The efficiency of the telephone cannot be fairly judged and tested in a large city where the wires are supported on poles and buildings."

"Are you still working and studying over the telephone?"

"Yes, but as yet it has not been improved. The same telephones which were manufactured several years ago are still in use in many places. There have been many additions to the telephone, but no real improvement to the instrument itself has been made. It is these additional contrivances which make the cost of the telephone to the subscriber so great. For example, the call bell which you see on every box costs more than the telephone itself. There are dozens of men in this and other countries laboring to increase the usefulness of the telephone."

"What additions or improvements are likely to be made soon?"

"I may say in a general way that the telephone will be made much more automatic. There will be less loss of time to the subscribers, and less mechanical friction and complexity."

INTENSIFYING THE SOUND.

"Is it possible to intensify the sound so that the voice issuing from the receiver may be heard in the remote corners of a large room?"

"Yes, that result can be reached, and probably will be. We find this difficulty, however: when the sound is intensified it is at the expense of distinctness and of perfect articulation. This fault can probably be corrected in a measure, so that if persons desire it they will be able to sit some distance from the telephone and hear all that comes through the receiver. The transmitter can also be made to convey sounds brought to it from a distance. If the improvements are made, it is not certain that there will be a very general demand for telephones which would bring the voice through the receiver to all parts of the room. Many persons would regard it as a convenience, and many other persons would consider it to be a very objectionable improvement, because conversation of a private nature could not be carried on."

"Will the relay system be brought into use when it is desired to transmit telephonic messages long distances?"

"Some method for repeating messages may have to be devised, but it now seems to me that it will hardly be necessary to resort to modifications of any of the principles used by the telegraph companies. I do not see what there is to be gained by strengthening the current at various points along the line. The current does not make the sound; it is caused by fluctuations communicated by the voice. A powerful current will not lend additional power to these fluctuations. It may be that repeaters or relays will be used, in some way, but at present I cannot see the necessity for any such system. If the wires be properly made, and so placed as to be as free as possible from the disturbing influences to which they are now subject, I can see no reason why a message cannot be easily and distinctly communicated by telephone to a distant office without being repeated or assisted on the way at intermediate stations. This, however, is one of the points which I am now working upon, and I am not prepared to speak definitely and precisely in regard to it. I have given you the views which I believe will prevail, and which I think will be successfully tested by practice."

"Will the late decision in the telephone suit be of benefit to the public in any way?"

"Yes, I think it will be. The company being free from legal restrictions can now carry out plans for improving and extending the service in all parts of the country."

DETERMINING THE CAPACITY OF THE EAR.

"Are you engaged in experiments other than those which you are making with the telephone?"

"I have here," said Professor Bell, unlocking a long, shallow black-walnut case, "something which may be of interest. It is an instrument for accurately measuring the hearing capacity of the human ear, and is, as you see, composed of one stationary and one sliding coil, between two horizontal rods, on one of which is a graduated scale reduced to the metric system. A telephone receiver is attached to the instrument, and the current is supplied by a magneto-electric machine which has a wheel composed of alternate sections of conducting and non-conducting surfaces, by means of which the current is rapidly and regularly closed and opened. A musical sound is produced which the telephone receiver communicates to the ear. Holding the receiver to the ear, the operator moves the sliding coil from the stationary one, and as the distance between the coils increases the sound grows fainter and fainter, and finally is lost altogether. The scale on the side rod marks the point which the sliding coil had reached when the sound ceased to be heard. If a standard of normal hearing capacity can once be obtained it will be an easy matter to measure the exact capacity of every ear which is tested. Every element by the use of this instrument is calculable."

"Have you attained a sufficiently accurate standard of hearing?"

"Not yet, but I hope to do so soon. This week I have been making a number of tests in the public schools of New York. I have a standard of abnormal but not of normal hearing. I find that this instrument will be of great use in the public schools. It is estimated that 10 per cent. of the school children of New York City have slight defects of hearing, and that 1 per cent. of this number are so deaf that they derive no benefit from the usual methods of instruction. The scholars know, of course, when their hearing is bad, but the teachers, as a rule, do not, and often think a child dull when it is only deaf. If the teachers were aware of the infirmity, and understood it, the pupil whose hearing was defective could always be given a position in the room and classes which would enable him to profit by the instruction which he is now, in many cases, losing. I find a great difference in the hearing capacity of people. Some persons can hear equally well with both ears, but most persons have a greater hearing capacity in one ear than in the other. The hearing capacity ranges from zero to an abnormal degree of acuteness. By testing the ears of several hundred persons I will be able to reach an average capacity of hearing which I can safely take for a standard."

"How was your attention directed to this subject?"

"At a convention of the teachers of deaf mutes held in New York, I was made chairman of a committee which was appointed for the purpose of devising means for testing and measuring the hearing capacity of mutes. It has been discovered that a very large number of perons who are classed as deaf mutes have, in reality, considerable hearing capacity. I have been able to discover this latent capacity by means of this instrument, and when it is found that a patient can be made to hear it is not a matter of great difficulty to develop the hidden power and to teach the patient to hear and speak, though, as a matter of fact, hearing is not necessary to speech. I mean by that that deaf mutes can be taught to talk; that in several countries of Europe they are treated so successfully that more than 65 per cent. of them learn to use their vocal organs. In the United States this matter has been neglected, and only 14 per cent. of the deaf mutes are taught to speak. It is my hope that this instrument will be a powerful factor in the restoration of speech and hearing to a multitude of persons, and I am extremely anxious that it may become of use to school children and to teachers. There are probably 1,400 children in the public schools of this city who, on account of defective hearing should be given special advantages. I trust my invention will be instrumental in discovering them."

How to Renew Exhausted Porous Cups.

Editors Electrical Review:

SIRS: Prematurely exhausted porous cups may be entirely renewed and the full strength obtained for the course of their natural lives by boring a hole through the lead cap into the carbon, and inserting therein a tight-fitting screw, which shall bear firmly against the lead and make a good electrical connection between the cap and the carbon. Prism carbons, which have "weakened" in advance of their usual term, may be saved in the same way, and considerable service obtained from them after they have become, in appearance, worn out. Mr. H. W. Ensign, formerly inspector at Galveston, and myself, in experimenting with some porous cups which had failed upon short service, discovered that a non-conducting film had formed between the carbons and their lead caps. By restoring the electrical connection, we found that we had restored the strength of the element.

Mr. Lockwood, in his valuable "Practical Information for Telephonists," says: "An occasional lookout should be kept for the formation of white lead between the carbon and its lead cap." This is all that I have found relating to the subject, though my search has not been extensive. However, the white substance which exudes from the surface of the cap appears to be a good conductor, but the film of matter which forms inside between the carbon and the cap affords an enormous resistance. I have noticed that it not infrequently happens that carbons which are badly afflicted with the formation of white lead, remain perfectly good and full of vigor for months, while those which gave no outward sign have rapidly declined. It is true, however, that most of the early played-out ones show symptoms of exudation.

The facts I have set forth may have been known to electricians, but to me they are new, and their value is so apparent that I risk claiming them as an original discovery.

Galveston, Dec. 16. G. W. FOSTER.

.... It is thirty years since women were first admitted as operators in the telegraph offices in England, and the *Pall Mall Gazette* says the story goes that the Queen herself has done much to promote their admission. Gen Wylde, one of the directors of the Electric International Telegraph Company, and in 1853 equerry to Prince Albert, is said to have suggested the idea to her Majesty, who at once entered into the plan with much sympathy. The experiment was begun with a few girls, but their number has so steadily and, since in 1870 the telegraphs were bought up by the Government, and even more since Mr. Fawcett has become Postmaster-General, so rapidly increased, that at present no less than 659 women are employed at the Central Telegraph Office in London, and about 350 more at the different telegraph and postal branch offices of the metropolis. At Liverpool, Glasgow, Manchester, and other provincial centers, a considerable number earn their living in this branch of the civil service, and besides these there are 900 similarly employed outside the civil service.

Of the women at the Central Telegraph Office, 424 are second-class telegraphists, receiving weekly pay of 10s., 12s. and 14s., rising by 1s. a week per annum to 17s., and then by 1s. 6d. per week per annum to 27s. Of first-class telegraphists there are 196, with a salary of 28s., rising by 1s. 6d a week per annum to 34s.; 15 assistant supervisors receive £90, and rise by £5 per annum to £110; 15 others receive a salary of £110, rising by £6 per annum to £140; the 8 supervisors receive £150; 6 of these rise by £8 per annum to £180, the two remaining ones to £225. The matron receives £130, rising by £10 per annum to £250.

The daily work of the female telegraphist extends over eight hours, within the period of from eight in the morning to eight at night. If they work ten hours per day one week, they only work six hours a day the week after. No telegraphist is allowed to leave the premises between the working hours, but as dinner is served in the spacious dining rooms, two of which belong to the women and two to the men, and as breakfast and tea are provided for the whole staff employed at the General Telegraph Office, this is no troublesome regulation. The tea is brought round to the desks by a special staff of twenty-four female servants; the cost of this "afternoon cup of tea, with a couple of slices of bread and butter," amounts to no less than £1,500 per annum. Breakfast for the early comers and tea are provided free of cost. It occurs occasionally that the female telegraphist has to do Sunday work; night work she is never expected to do, "for," reasons the head of the institution, "no respectable mother would like her daughter to be out alone after eight at night or before eight in the morning, and consequently we should have a lower class of girls than is at present the case." To judge from appearances, the present female staff are girls and women of a very superior class. They work in large rooms, at present mixed with the men; sometimes a single female telegraphist amid a number of men, sometimes *vice versa*. All are busily intent on their work. Neatly attired, often with a vase of spring flowers by their side, there is an air of vigor and sprightliness about them which harmonizes well with the busy scene of which the women telegraphists form by no means the least attractive feature. But, notwithstanding bright looks and rosy cheeks, the report of their state of health, as compared with that of their male colleagues, is not very satisfactory. Long absences caused by serious illness are rare, but the frequent occurrence of an absence of a day or two is one of the chief disadvantages of the employment of women in the telegraph office. "Of course," says Mr. Fischer, "they are differently constituted from men, and for this we make due allowance, but experience has taught us that in many cases the absence is due only to a want of energy. They seem to be unable to rouse themselves when sometimes overcome by a feeling of languor. The mothers, too, are, no doubt, often to be blamed for encouraging their daughters to stay at home. We cannot depend on the women in this respect as we can on the men." One-third of the wages is deducted on an absence from a day to six months, but they seem well content with this arrangement.

.... The *Mining Gazette* has the following comments on use of copper wire:

It is now admitted by practical electricians, after thorough tests, that copper wire is the best and most economical for telephone and telegraph purposes. It is claimed that a perfect wire for this object has yet to be made, and that before it can be produced, bar copper possessing certain qualities is necessary.

From casual conversations we have had with persons who have studied the nature of the copper of this region in connection with the transmission of electricity, it is probable that with a full understanding of what is wanted, the manufacturers will be able to make a "line wire" from Lake Superior bar equal to the demand. Recent discussions, however, on this subject, indicate that something different may be required from what can be produced from ordinary wire bars.

All commercial copper, we are informed, contains a small amount of oxygen, which exerts an influence on the working qualities of the metal, as well as on the character of the article produced from it. To what extent oxygenated copper stands in the way of a perfect telephone and telegraph wire is a matter that is now being determined by men competent to carry on experiments in each department involved.

As we understand it, telegraph and telephone companies want a wire possessing all of the desirable qualities combined of hard drawn and annealed copper wire. That is, a material that has all the conductivity and tensile strength of hard drawn wire, with the malleability and ductility of annealed wire. It is claimed that these qualities can be blended in a wire made out of copper that is free from oxygen. Deoxydized copper wire, it is also said, would be proof, to an extent, against the effects of sulphurous gases.

From what information we have at hand, we think we are safe in saying that copper, which is one of the most valuable base metals, is sadly neglected in the way of mechanical experiments and practical metallurgical tests. The quality of iron and steel is changed to suit the particular purpose for which it is to be applied. There has been but little attempt made to treat copper in a like manner for special objects. The metal trade is beginning to recognize copper as a commodity destined to play a much more important part than it has in the industrial progress of the world; and it will see that the employment of the material in the various channels that suggest its services, is not hampered in the future by a lack of thorough practical tests, in order to bring out its good points in the interest of the field of mechanics and arts. Nature has deposited the copper in this district entirely free from oxygen, and for some special uses we may have to imitate nature, as close as possible, in the way of deoxydized copper.

Copper wire can be made possessing a tensile strength of over three times its weight per mile, with all the requirements for overhead telegraph lines, which at the same time would stand as much bending and twisting to break, as it takes to tear asunder commonly manufactured annealed wire Mr. Maver, who is writing a series of articles for an electrical journal on telegraph wire, intimates that soft, or annealed copper wire is used for cable purposes, which is liable to injury when raised for repairs. Hard drawn deoxydized copper could be employed in this direction with much less liability to damage, and with the advantage that it would add greatly to the strength of the cable.

The early history of telegraphy shows that there was no copper produced that compared in the way of conductivity with the same metal that is available to-day. A table published some time ago in the *Scientific American*, showed that the first cable, which was manufactured in 1851, had a conductivity of only 42 per cent., while the last cable, which was made in 1883, had a conductivity of $97\frac{9}{10}$ per cent. Some of this difference between the 1851 and 1883 cables may be owing to defects in the manufacture of the wire, but the chief variation, we think, can be attributed to the improved quality of copper.

.... Hearing in the case of Senator Mahone and others against the Southern Telegraph Company, in which a receiver is asked for, begun at Norfolk, Va., last week, before Judges Bond and Hughes, of the United States Circuit Court. General B. F. Butler appeared as one of the counsel for the plaintiffs, and General Bradley T. Johnson appeared for the defence. The defence moved to dismiss the suit for want of jurisdiction, and the discussion of this motion consumed the entire day. The motion was overruled, and the case was adjourned until Monday, when, the court said, nominations for a receiver would be heard. The plaintiff, Senator William Mahone, was in court, but the defendant company appeared only by attorneys, and raised the question of jurisdiction, contending that the telegraph company cannot be sued in Virginia, it being a New York corporation, and they argued that it did not appear from the record that any effort had been made by the plaintiff to have the trustee give an account of the property intrusted to him before asking the court to interfere. John S. Wise and General Butler contended for the plaintiff that the jurisdiction of the court was clear and unquestioned, and stated in argument that bonds of the Southern Telegraph Company to the amount of $1,300,000 had been abstracted from the vaults of the Bankers' Loan and Trust Company by A. W. Dimock, president of the Farmers' and Merchants' Telegraph Company, and are now found in the hands of the receiver of the latter company as assets, and, although obtained by fraud, they are liable to pass into the hands of innocent persons, and thus impair greatly the value of the plaintiffs' property. Nothing but the interference of this court now, they contended, would save the plaintiffs and others similarly situated from irreparable injury. There was a large attendance, and the arguments were listened to with the closest attention.

TELEGRAPHIC

.... General Manager Rosener, of the Postal Telegraph Company, says that a report of the financial condition of the company would be made in about thirty days. The reason why no exhibit was presented at the stockholders' meeting on Tuesday, it was explained, was in consequence of the complicated nature of accounts arising from the dissolution of the pools with the Baltimore and Ohio and Bankers and Merchants' Companies.

.... Local telegraph circles are agitated by reports of the formation of a new and powerful telegraph syndicate, which, it is said, will, during the early part of the new year, actively enter into opposition to the Western Union. John W. Mackay of the Postal company, Robert Garrett of the Baltimore & Ohio, James Gordon Bennett and the bondholders of the Bankers and Merchants' company are said to be the moving spirits in the enterprise. These combined interests include over 200,000 miles of wires now in operation, representing a plant valued at about $30,000,000. It is said that this combination was arranged in New York at a conference participated in by Bennett, Mackay and Garrett, prior to the departure of Bennett and Mackay for Europe. The first move made will be the payment of $1,000,000 of interest due on contracts of the Bankers and Merchants' and $300,000 more in fitting up the gap between Pittsburg and Steubenville, O., and from Montgomery, Ala, to New Orleans. It is believed that this syndicate means business, and is preparing to secure all the lines not controlled by the Western Union Co.

.... The Commercial Cable Company opened its offices for business last Monday night, as announced. The rate charged is forty cents a word, as against fifty cents a word charged by the other companies. This morning the cable companies controlled by the Western Union announced a rate reduction to forty cents a word, to meet the "cut" of the Commercial Company, as explained in the following cable dispatch:

"LONDON, December 24.—The old cable companies have reduced their tolls to the same figures as those established by the Commercial Cable Company; that is, 40 cents a word for general business messages to Great Britain and France, 20 cents for plain press messages transmitted in their regular order, and 10 cents for 'deferred' press business. The officers of the companies are consulting as to what further steps they will take in the premises."

At the office of the new company an officer of the company said to a reporter: "We do not intend to reduce our rate because it is met by a similar rate from the other companies. We did not go into this business for the purpose of injuring other cable companies, but to make money for ourselves. Of course, we knew that the rate would at once come down to 40 cents, and we were prepared to see it come down still lower. If the Western Union people had put the rate down to 30 cents a word, we should have followed suit, but as it is we are quite satisfied, and hope that the other cable companies are equally pleased."

The following table shows the gradual reduction in cable rates since the opening of the first Atlantic cables:

1866—$100 for 20 words or less.

From November 1, 1867, $50 for 20 words or less.

From December 1, 1867, $25 for 10 words or less

From September 1, 1868 $16.85 for 10 words or less.

From June 1, 1869, $10 for 10 words or less.

From August 10, 1869, $7.50 for 10 words or less.

From December 12, 1870, $15 for 10 words or less.

From July 1, 1871, $10 for 10 words or less.

From May 1, 1872, $1 per word.

From May 1, 1875, 50 cents per word.

From December 24, 1884, 40 cents per word.

ELECTRICAL AND SCIENTIFIC

* * Transfer paper is made by rubbing thin, strong tissue paper with a composition consisting of two ounces of tallow, one-half ounce of powdered black lead, one-fourth pint of linseed oil, and sufficient lamp-black to make it of the consistency of cream. These should be melted together and rubbed on the paper while hot. When dry it will be fit for use.

* * In a paper before the Academie des Sciences, Paris, on "An experimental Demonstration of the inversion of the electromotive force of iron and copper contact at a high temperature," M. F. E. Le Roux, continuing the investigation of a fact ascertained by the French *savant* Peltier, that the service of contact of two heterogeneous metals becomes heated or cooled according to the direction of the electric current by which it is traversed, found that, at or about a temperature of 1,000° C., a current from copper to iron heated the surface of contact, but cooled it at the ordinary temperature.

* * At a recent meeting of the Societe Internationale des Electriciens, M. Hospitalier read a paper on "Uniformity of Electrical Definitions, Conventions, Notations and Symbols," at the end of which he moved the following resolution: "We propose the nomination of a commission of electrical notation, charged with studying the question, and giving our proposition the sanction which seems best in the interest of electrical science." This was seconded by M. G. Cabanellas, and adopted unanimously, the following members being appointed to serve on the committee: MM. Ed. Becquerel, E. E. Blavier, Marie-Davy, Tresca, H. Becquerel, G. Cabanellas, J. Carpentier, Gauthier Villars, E. Hospitalier, Maurice Levy, G. Lippmann, Felix Lucas, Mercadier, De Meritens, D. Monnier, D. Napoli, Pollard, J. Raynaud and V. Williott. The first meeting of the Electrical Notation Committee was fixed for the 10th inst.

* * A new and simple invention, which, it is claimed, is likely to supersede all other logs now in use, in on exhibition in Gloucester. It is the invention of two young men of that place. The object of the invention is to register, by means of an electric current on board of sail or steam vessels, the number of miles traversed through the water. Considering the great inconvenience of those now in use, this new log is said to be a wonderful invention. The flange spindle has a projected point, and at each revolution of the propeller the projecting point touches the spring on the diaphragm, presses it against a cable wire, and closes the circuit. On board the ship is placed a register, and when a mile has been made the figure one appears on its face. With the use of this log the register can be taken without raising the log from the water.

* * M. J. Rene-Benoit has constructed some standards, the existence of which is equal to an ohm within one hundred thousandth, which were submitted to the French Academy at the meeting of the 17th November. As those standards are too fragile and inconvenient for ordinary use, he has also made a certain number of copies, which give the same resistance in a more manageable form. They consist of columns of mercury, contained in tubes bent back symmetrically several times upon themselves, and dipping at the top into cups of sufficiently large diameter. The cups are connected with the tube by india-rubber rings, and remain open, which facilitates adjustment and permits of renewing the mercury when occasion requires. The copies have been adjusted by comparison with the standards by carefully grinding away the ends of the tube until they give the same resistance as the standards. They have always, like the standards themselves, been filled *in vacuo*.

* * At the distribution, on the 10th inst., of prizes awarded by the Science and Art Department, at the
Professor Tyndall passed in review the advance made in scientific knowledge. In the course of his observations, the professor remarked that, coming near to our own time, we had the number 772 expressing the mechanical equivalent of heat, and in the whole range of science there was not a more important number than this, indissolubly associated with the name of James Prescott Joule. Based on Joule's equivalent of heat was the wider principle of the "conservation of energy," which affirmed the agencies of nature to be indestructible while they were mutually convertible. There was no such thing as the creation of energy in the universe, and, if a new form of energy should appear, the principle of conservation affirmed that some other form of energy must have disappeared to produce it. With Joule's equivalent in our hands we might go into the universe and calculate, as Meyer and Thomson had done, how suns might be generated by the collision of planetary masses, or, asking whence came the heat stored up in our wood and coal, reply that it was derived from the sun. We might pass from the vegetable to the animal world, and learn that all the energies of the latter were also derived from the sun. One could not lift the arm, nor use the voice, without bringing into play the law of "conservation of energy."

* * The total length of European railways at the end of 1883 was 113,577 miles, against 110,678 miles at the close ot 1882, which shows an increase during the past year of 2,859 miles. The length of the railways of the various countries at the beginning of this year was as follows, in kilometers and miles:

	Kilometers.	Miles.
Germany	36,807	22,262.34
Great Britain and Ireland.	30,179	18,710.98
France	29,688	18,400.56
Russia	25,111	15,598.32
Austria	20,850	12,957.00
Italy	9,453	5,860.86
Spain	8,251	5,116.62
Sweden and Norway	7,978	4,946.36
Belgium	4,269	2,646.78
Switzerland	2,752	1,706.24
Holland and Luxemburg.	2,523	1,564.36
Denmark	1,800	1,116.00
Roumania	1,517	940.54
Portugal	1,494	926.28
Turkey, Bulgaria and Roumelia	1,394	864.28
Greece	22	13.64
	183,188	113,576.56

There were in the United States 120,552 miles of railroad according to the last edition of "Poor's Manual."

—— M. Delaurier has invented an electric lamp having for its essential feature a hammer which carries one of the carbons and receives a rapid reciprocating motion from a coil through which an intermittent current passes. Sparks caused by the alternate contact and separation of the carbons produce the effect of a continuous light.

On the Discharge of Electrical Accumulators.

By E. Frankland, F.R.S.

In a communication to the Royal Society on this subject (*Proc. Roy. Soc.*, Vol. XXXV., p. 67) I described certain experiments which went to prove that the active material in an uncharged accumulator (in which, when charged, spongy lead and lead peroxide are the opposing plates) is lead sulphate; that, in charging, this lead sulphate is decomposed on the positive electrode, the formation in both cases of hexabastic sulphuric acid, and that in the discharge these chemical changes are reversed, lead sulphate being reproduced on both electrodes and plates. I also stated that the sulphuric acid thus added to or withdrawn from the liquid contents of the cell can be made to indicate by change in specific gravity the degree of charge in the cell at any given moment. At the conclusion of the paper I expressed a hope that further experiments would enable me to denote in terms of current from the cell the definite relation between the amount of energy stored and the weight of sulphuric acid liberated. I have not as yet, however, obtained results which would justify me in announcing this equivalent, but I venture to think that the details of some experiments which I have made with this object may not be altogether uninteresting at a moment when the storage of energy is attracting so much attention.

The storage cell employed contained 10 plates, each having two active surfaces of 11 inches by 9 inches. Rejecting the free sides of the two endmost plates, the total effective surface was 12.3 square feet. These plates were completely immersed in dilute sulphuric acid, of which the cell contained about 14 imperial pints. The cell was fully charged in series with several others by a current from a Siemens shunt machine, varying usually from 15 to 20 amperes, and it was then allowed to rest for three days. The discharge was made through a piece of platinum wire, 1.035mm. in diameter and about 10 inches long. Carefully sheltered from drafts, this wire was maintained at a red heat just visible in the dark so long as the current did not sink below 17 amperes. The current was measured by a Siemens electro-dynamometer constantly included in the circuit. As the complete discharge occupied 73 hours, it had to be frequently interrupted. These interruptions are not mentioned in the following tabulated results, but they are noted in the accompanying diagram, which shows these results in the form of a curve. The current maintained itself at between 19.61 and 18.09 amperes for nearly 22 hours, and then fell very suddenly in the course of about an hour to less than three amperes, at which rate it continued for upwards of 50 hours. At the end of this time the current was still 2.57 amperes, when it was stopped at 10:30 P.M. At 6:30 the following morning, on re-establishing the circuit, no perceptible current passed.

The following are the tabulated results of the discharge:

Date. April.	Duration of discharge.	Currents in amperes.	Ampere hours.
	H. M.		
7	1 0	19.61	19.61
8	2 30	19.24	48.11
8	5 6	18.81	95.98
10	3 0	18.61	55.88
10	0 45	18.37	18.78
10	4 38	18.28	84 39
10	4 15	18.23	77.48
10	0 30	18.09	9.05
10	0 8	17.77	2.37
10	0 18	15.37	4.61
10	0 12	9.45	1.89
10	0 9	5.42	.75
10	0 23	3.67	1.41
15	1 14	2 87	3.54
15	6 50	2.78	18.65
15	2 55	2.41	7.03
16	2 15	2.78	6 14
16	0 45	2.65	1.99
16	1 55	2.57	4.98
17	5 10	2.57	13 28
17	2 20	2.49	5.81
17	1 5	2.41	2.61
18	15 50	2.57	40.69
19	1 15	2 78	3.41
19	3 15	2.57	8.35
20	2 22	2.78	6.46
20	3 0	2.57	7.71
	73 5		545.81

The cell therefore kept up a current for 73 hours 5 minutes, and delivered an aggregate charge of 545.81 ampere hours. Of this charge 404.18 ampere hours were delivered with an electromotive force of about two volts, whilst 141.63 ampere hours were delivered with an E.M.F. of only about three volts. This result may be tabulated as follows:

	Ampere hours.
Useful electricity or electricity of high E.M.F. (two volts or upwards)	404.18
Useless electricity of low E.M.F.	141.63
Total	545.81

In the experiment just described the discharge at high electromotive force was rapid, but the cell had many intervals of rest, several of them long ones. Thus, after the first hour's discharge at the rate of 19.61 amperes, there was a rest of 21½ hours. Then the discharge was continued at the rate of about 19 amperes for 7 hours 36 minutes, followed by a rest of two days, when the discharge was maintained at nearly the same rate through the same resistance for 8 hours 23 minutes. Then came another rest of four days, at the end of which time the discharge started at exactly the same rate as that at which it had previously left off, and continued at very nearly the same rate for 4 hours 45 minutes longer, when it suddenly fell off to about 2¾ amperes.

In the next experiment, which was made with a cell similar in all respects, the heavy current was taken continuously up and down the fall, with the exception of one break of 14 hours at the end of six hours. The following are the numbers noted during the discharge:

Date. June.	Duration of discharge.	Currents in amperes.	Ampere hours.
	H. M.		
9	6 5	17.47	106 23
10	1 40	17.47	29.11
10	1 60	17.15	31.44
10	1 40	16.50	27.50
10	1 15	4.06	5.07
10	0 35	3.62	2.05
10	1 30	3.15	4.72
10	2 5	3.28	6.83
11	0 5	11.69	.97
11	0 12	11 33	2.27
11	0 6	9.54	.95
11	5 0	2.37	14.35
11	6 20	1.82	11.53
12	0 5	9.10	.76
12	0 5	6.42	.54
12	0 5	4.06	.34
12	0 5	2.57	.21
12	1 40	2.03	3.38
12, 13	36 20	1.82	66.13
14	10 40	1.32	19.41
Here current of 22.15 was passed through cell for 1 hour, and intervals of 3 hours allowed before continuing discharge.			
14	0 3	9.96	.50
14	0 7	8.03	.95
14	0 10	4.06	.68
14	0 30	3.70	1.35
14	0 10	2.87	.48
14	0 10	2.57	.43
14	1 20	2.41	3.21
14	0 25	2.03	.35
14	6 35	1.82	11.98
15	24 0	1.82	43.68
16	20 0	1.82	36.40
16	2 0	1.58	3.16
17	0 1	2 87	.05
17	0 1	2.08	.03
17	0 3	1.82	.09
17	0 50	1.58	1.32
17	12 20	1.29	15.91
18	0 1	2.41	.04
18	0 15	1.58	.39
18	0 45	1 29	.97
18	0 30	.91	.45
	147.39		457.26

The current maintained a nearly uniform rate of between 16½ and 17½ amperes for 11½ hours, or only for about one-half the time in the previous experiment. It then suddenly sank to little more than 3 amperes, but rose again for a few minutes to over 11 amperes after a rest of 12 hours. It then sank to 3 amperes, and finally to less than 2, after nearly 12 hours' continuous discharge; but after 14 hours' rest it again rose for a few minutes to nearly 10 amperes, to sink in 15 minutes to 2.57, and in another hour and 40 minutes to 1.82 ampere, at which rate it remained for 47 hours continuously.

Under perfectly constant conditions of discharge it was interesting to try the effect of interpolating a fresh charge from the dynamo. Accordingly the discharge was interrupted, and immediately a steady current of 22.16 amperes was sent through the cell for exactly one hour, and the cell was then allowed to rest for three hours. On recommencing the discharge through the same resistance as before, a current of 9.96 amperes was obtained; but this was maintained for three minutes only, and at the end of an hour it had sunk to 2.87 amperes. It was only, however, after the lapse of eight hours that the rate of 1.82 ampere was resumed, and this was afterwards continuously maintained for 52 hours. Thus, of the 22 ampere hours with an E.M.F. of about 25 volts put into the cell, only 8.94 ampere hours came out again with a higher E.M.F. than that possessed by the previously constant current of 1.82 ampere. Moreover, the E.M.F. of

the augmented current never exceeded 1.09 volt, whilst in 20 minutes it sank to .49 volt. This result shows how wasteful it is to keep a storage cell in circuit after the high E M.F. portion of its charge has been extracted. Altogether the complete discharge of this cell occupied 147 hours 39 minutes, and there was obtained:

	Ampere hours.
Useful electricity or electricity of high E.M F. (two volts or upwards).....	194.38
Useless electricity or electricity of low E.M.F , omitting the 22 15 amperes hours interpolated.....	240.78
Total.....	435.11

The cell, therefore, contained a smaller aggregate charge than the previous one, but what is of much more importance, the proportion of useful electricity was greatly diminished; for, whilst in the first experiment the proportion of useful or useless electricity was 5 : 7 : : 2, in the second it was only 1 : 6 : : 2. It can scarcely be doubted that this diminished proportion was due to the much more continuous nature of the discharge in the second case.

In order to test this conclusion, however, a third cell was submitted to experiment. This cell contained 13 pints of diluted acid, but only eight plates 8.5 inches × 11 inches, or an aggregate effective surface of only 9.09 square feet, as compared with 12.3 square feet in each of the former cells. On this account the cell was discharged through a somewhat higher resistance, so as to obtain a lower rate of discharge.

Duration of discharge.	Current in amperes.	Ampere hours.
H. M.		
9 45	16.2	157.9
6 35	15.8	104.0
2 45	15.5	42.2
1 0	14.8	14.8
2 20	14.7	34.3
15	13.2	3.3
20	12.8	4.3
15	10.9	2.7
25	10.4	4.3
25	9.9	4.1
15	6.6	1.65
25	4 6	1.91
20	3 75	1 25
25	3.28	1.36
1 0	2.57	2.57
50	1.82	1 52
2 30	1.29	3.22
111 30	.91	101.46
141 20		486.84

The cell maintained a nearly uniform current, averaging 15.8 amperes for almost the same time (22 hours) as the first cell. The current then sank, not quite so suddenly, to 91 amperes, at which rate it continued steadily for 111½ hours. During the course of this discharge the cell had the following period of rest: Discharge, 6 h. 5 m.; *rest*, 25 h. 35 m.; discharge, 5 h.; *rest*, 8 h. 30 m.; discharge, 4 h. 20 m.; *rest*, 6 h. 10 m.; discharge, 4 h. 40 m.; *rest*, 8 h. 15 m.; discharge, 121 h. 15 m.

These periods of repose had a most beneficial effect on the economic value of the charge. For, whilst the cell, discharged with but little rest, gave a proportion of useful to useless electricity of only 1 : 6 : : 2; this cell, with intermittent discharge, yielded a result expressed by the proportion 6 : 5 : : 1, which is even higher than that obtained from the cell used in the first experiment. The complete discharge of this cell occupied (exclusive of the periods of rest) 141 hours 20 minutes, and there were obtained: Useful electricity, 371.9 amperes; useless electricity, 114.9 amperes; total, 486.8 amperes.

In all these experiments moderate currents only were drawn from the cells, such as would be used for the supply for 14 or 15 Swan lamps of 20 candle-power; but much heavier currents can be obtained if desired, for Messrs. R. E. Crompton inform me that they have obtained from a cell of 12 plates of the same construction a steady current of 250 amperes. It would thus be possible, by coupling in parallel only 30 such cells, to obtain for a short time a steady current of no less than 7,500 amperes. The results of these experiments permit the following conclusions to be drawn:

1. The energy of a charged storage cell is delivered in two separate portions, one having an E.M F. of 2 volts and upwards, the other an E.M.F. of 5 volts or under; one of these may be termed useful electricity, the other useless electricity.

2. The proportion of useful electricity obtainable is greatest when the cell is discharged intermittently, and least when the discharge is continuous.

3. Neither in the intermittent nor continuous discharge at high E.M.F. is the current, through uniform resistance, augmented by rest. At low E.M.F., however, the current, after continuous discharge of the high E.M.F., is greatly augmented, but only for a few minutes. This augmentation of current at low E M.F. after rest is barely perceptible when the high E.M.F. discharge has been taken intermittently.

4. The suddenness of fall in potential indicates two entirely distinct chemical changes, the one resulting in an E.M.F. of about 2.5 volts, the other in one of 8 volts

5. The chemical change producing low E.M.F. is the first to occur in charging, and the last to take place in discharging a cell. It is the change which occurs during what is called the formation of a cell, and in the interest of economy a reversal of this change should never be allowed to take place.

6. It would not be difficult to suggest an explanation of the nature of these two chemical changes; but I refrain, pending their actual investigation in which I am now engaged.

7. Currents of enormous strength may be obtained from storage batteries coupled up in parallel. For instance, a current of 25,000 amperes is quite feasible from only 100 cells. Such a current reduces to insignificance the output of the largest dynamo ever built. It is to be hoped that currents of this magnitude will open up new possibilities of research into the constitution of matter.

—— The new naval steamers the Atalanta, Boston and Omaha, are to be lighted with electricity in consequence of the success of the incandescent system, which is in use on the Trenton. Despite defective insulation of the wires, the experiment proved of material advantage to the comfort and health of the officers and crew of the latter steamer. In order to determine the relative merits of the different systems of electric lighting, each vessel is to be furnished with a plant from a distinct source. That for the Atalanta will be supplied by the United States Electric Lighting Company of New York; that for the Boston by the Brush Electric Company of Cleveland, and that for the Omaha by the Consolidated Electric Lighting Company of New York.

The Plante Accumulator Formed with Horizontal Lead Plates.

In this form of the accumulator the plates of lead are arranged horizontally, the sides being bent vertically, as shown in Fig. 1,

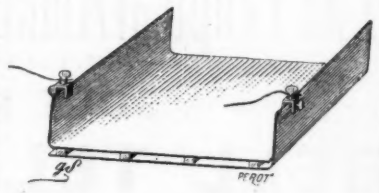

FIG. 1

and piled up in a gutta-percha lined wooden tub, or in a stoneware trough, filled with water acidulated with sulphuric acid. The plates are separated from one another by frames or sashes made of rods of gutta-percha, or wood soaked in paraffin, forming large meshes having about 1 decimeter (about 3.9 inches) square surface. The poles of each odd-numbered plate are joined together at one side by a metallic connector, and the poles of the even-numbered plates are connected in the same manner on the other side. Fig. 2 represents only six plates thus superposed, but a much greater number may evidently be superposed, thus obtaining a very great surface in a very small space.

These plates, thus laid out flat, may be constructed of very large dimensions. For a model of the medium size the following dimensions are convenient: Length, 40 centimeters (about 15½ inches); width, 30 centimeters (about 11¾ inches); and thickness, 1 millimeter (about .04 inch). The thickness of the frames of insulating rods is 1 centimeter (about .4 inch).

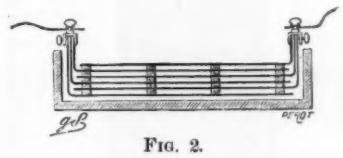

FIG. 2.

The tubs themselves are placed one above the other, like drawers, in a specially designed support built like a set of shelves, and compose, in this manner a series of couples that may be joined up in tension or quantity, as may be convenient. (See Fig. 3.)

In order to prevent the even plates from touching at their extremities, the bent portion of the odd plates, and *vice versa*, all of the plates at that extremity are placed in a groove in the last rod forming one of the sides of the insulating frames. This detail is not shown in the figure.

The lead plates thus bent or folded throughout their entire width have the advantage of

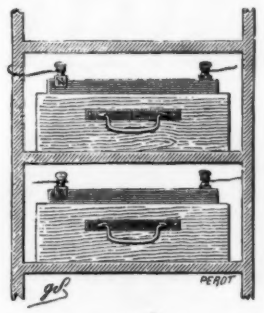

FIG. 3

offering electrodes of great surface, and therefore good and durable connections; whilst in all previous arrangements, when the relatively narrow plates get broken, it is difficult to make a good new connection on a new place in the plates already formed.

The construction of this form of accumulator is, as may be seen, very simple. It offers none of the difficulties of rolling up the plates concentrically, and appears to us preferable, when the battery is intended to remain in one place, to the arrangement in parallel vertical plates, employed by M. Plante some years ago, and generally adopted since in the many modifications which have been made in his accumulator. The plates placed vertically are apt, in fact, to buckle and come in contact after a time.

This arrangement lends itself, besides, very readily to the preliminary treatment with nitric acid, adapted by M. Plante to hasten their formation, for the plates can be immersed in the acid before being piled up, and in the same form that they should have when coupled.

Now that so many are actively occupied in the numerous applications to which the fruitful discovery of M. Plante is adapted, there is reason to hope that accumulators thus constructed and placed in the cellars of private houses, like small gasometers or reservoirs of electricity, and charged from a distance by dynamo electric machines, will solve the problem of domestic electric lighting.

The Wisconsin Telephone Company has recently completed the construction of a copper line, connecting Madison and Milwaukee, the distance is eighty-eight miles, and Supt. Hibbard reports that the results achieved are beyond his anticipations and in fact simply marvelous. Subscribers in Madison being as readily heard in Milwaukee, as if they were in the last named city. The guage is No. 12 Brown & Sharpe, and the wire was supplied by the Palmer Wire Company. This company has several large contracts for supplying copper wire to telephone companies.

ELECTRIC LIGHT NEWS

—— The Brush Electric Light Co. in New York runs from two stations 1300 arc lights, which require fifty dynamos, 1400 horse-power and 300 miles of wire.

—— Stein Bros. of Cleveland, Ohio, have just put in one of the Thomson-Houston machines with focussing light for photographic purposes, and they write that "it works to perfection."

—— The citizens of Jacksonville, Florida, have bought a Thomson-Houston plant, and that city will, in a few days be fully lighted with this well known system.

—— The New Haven Electric Light Co. have completed and are now occupying their new station which, it is safe to say, is the best equipped in the State, they are furnishing the city with about 50 lights, and have over 100 private lights in operation.

—— On Dec. 16th a charter was granted the Manufacturers and Merchants' Electric Light Co. of Lancaster, Pa. The capital stock is $20,000. The incorporators are W. K. Beard, Henry F. Diller, C. F. Meyers, R. M. Boleuius of Lancaster, and Geo. S. Brock of Philadelphia. They are going on to put in a 40 light arc plant at once, using the Remington system, with the Pennsylvania Diamond Drill Co.'s make of adjustable cut off engines; the same as has been used by the Pittston Electric Light Co. of Pittston, Pa.

The City of Lancaster has contracted with the U. S. E. L. Co. of Pa., for one hundred and twenty arc lights for the coming year, this is the 2d year they have had the contract, it was originally secured by S. Brock.

——An elegant exhibition of the wood carver's art is made in the recent improvements in the fire-alarm telegraph office in the dome of the City Hall. It consists of an elaborate counter in solid mahogany extending across and dividing the apartment. Several upright standards are surmounted by finely worked animals' heads, and the panels contain exquisitely cut bas-reliefs, representing a fireman turning in an alarm, the city seal, a vignette of Franklin, the State arms, and a spirited representation of a steam fire engine on its way to a fire. The reverse side of the counter is relieved by lighter woods, and the whole is surmounted by an ornamental glass screen in mahogany setting. The design was made and the entire work performed by Mr. Harry Heyman, assistant engineman of engine 22, in his leisure hours.

—— The Royal Electric Co. of Montreal Canada, have just invented several very valuable appliances applicable to the Thomson-Houston system.

It will tend very much to lessen the power necessary to produce lights, also in connection therewith very efficient cut-outs have been adopted which are approved by the insurance companies.

The Royal have taken the initiative for the general inspection of electric lines by the insurance viz.: that all lines should be run in strict accordance with the rules laid down by the board of fire underwriters.

The Royal have built and equipped stations in the following cities: Montreal, Hamilton, Ottawa, St. John, N. B., Quebec, Halifax, N. S., Peterboro, St. Catherines.

The Gas Company of the City of Montreal are now moving in a direction which shows very plainly that electric lighting is taking serious root. They are now putting up the large Siemens gas burners, and offering extraordinary inducements to consumers, with no doubt the evident intention of trying to run the Electric Light Co. out, but we would here say that the same thing has been tried in the United States without any effect upon the Electric Light Cos. Electric lights have come to stay and we might just as well try to stop the sun from shining and place electric lighting in the back ground, improvements are going on daily, and the zenith will soon be reached, and we can then all exclaim as croakers generally do—I told you so.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING DECEMBER 23, 1884.

309,522 Electric motor; William H. Chapman, Middlebury, Vt., assignor to the Chapman Electric Motor Company, of New York.

309,536 Regulator for electric generators and motors; Walter K. Freeman, Brooklyn, N. Y., assignor to the Monarch Electric Company, of New York.

309,560 Armature for dynamo-electric machines; Benjamin F. Orton, East Saginaw, Mich.

309,562 Electric motor; Charles C. Peck and William H. Chapman, Middlebury, Vt., assignors to the Chapman Electric Motor Company, of New York.

309,571 Means for overcoming static disturbances in telegraphy; Charles Selden, St. Louis, Mo.

309,572 Means for overcoming static disturbances in telegraphy; Charles Selden, Baltimore, Md.

309,573 Quadruplex telegraph; Charles Selden, Baltimore, Md.

309,585 Electrical apparatus for operating bolts; Wm. Vogel, Chicago, Ill.

309,600 Autographic reed telegraph: Byron A. Brooks, Brooklyn, N. Y.

309,606 Electric railway; Frederick H. Danchell, Maidstone, County of Kent, England,

309,617 Telephone call-box; Elisha Gray, Highland Park, assignor, by mesne assignments, to the Western Electric Company, Chicago, Ill.

309,735 Armature for dynamo-electric machines; B. F. Orton, East Saginaw, Mich.

309,742 Microphone; Francois J. Semal, Mons, Belgium.

309,751 Means for preventing false signals on reversals in quadruplex telegraphs; Henry Van Hoevenbergh, Elizabeth, N. J.

309,791 Telephone switch; John D. Lyle, Columbus, Ind.

309,809 Secondary electric clock; George Trippen and Frederick Trippen, Jr., Philadelphia, Pa.

REISSUES.

10,544 Illuminating point for electric lights; Charles F. Brush, Cleveland, O.

A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.

If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40.00. Various other Foreign patents may also be obtained.

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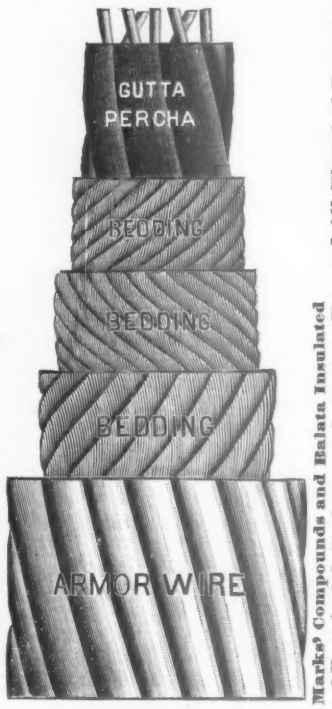

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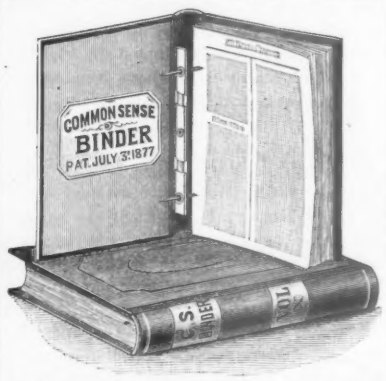

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